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THE LOCK GATES AT THE CHARLES RIVER DAM, BOSTON AND CAMBRIDGE, MASS.

By EDWARD C. SHERMAN,* Assoc. M. Am. Soc. C. E.

A general description of the new dam which is now being built across the Charles River, between Boston and Cambridge, Mass., was published in the Engineering News of Oct. 6, 1904. This was followed in the Engineering News of Jan. 12, 1905, by another article, in which are described the foundations of the lock and sluices and the shut-off dam to stop the tidal flow. Both articles were written by Mr. J. Albert Holmes.

As stated in the latter paper, it is intended, when the dam is completed, to keep the water in the basin at an elevation about 2½ ft. lower than mean high tide or about 7½ ft. above mean low tide. This will result in the gates of the lock in the dam being subjected to pressures alternating in direction with the fluctuations of the tide-water on the harbor side.

It is necessary that there shall be no obstruction to the navigation of the river, and accordingly the lock must be completed and in operation before the shut-off dam is built. The lock and its gates being nearly completed, a description of the gates may be of interest, especially as one of the gates was first operated on April 23, 1908, and the other on May 11, 1908, both with entire success.

The legislative act under the authority of which the Charles River Dam is being built requires the Charles River Basin Commission to construct a dam sufficiently high to hold back all tides and to maintain in the basin above it a practically permanent water level, this dam to be not less than 100 ft. wide. The act provides that a part of the top of the dam shall be a highway and authority is given the Commission to make a park of the remainder. The act also provides that the dam shall be furnished with a lock not less than 350 ft. in length between the gates, 40 ft. in width and 13 ft. in depth below Boston base, this base being about ½ ft. below mean low tide.

It was finally decided to make the lock 45 ft. in width and 17 ft. in depth below mean low tide. A general plan of the dam is shown by Fig. 1. (See next page.)

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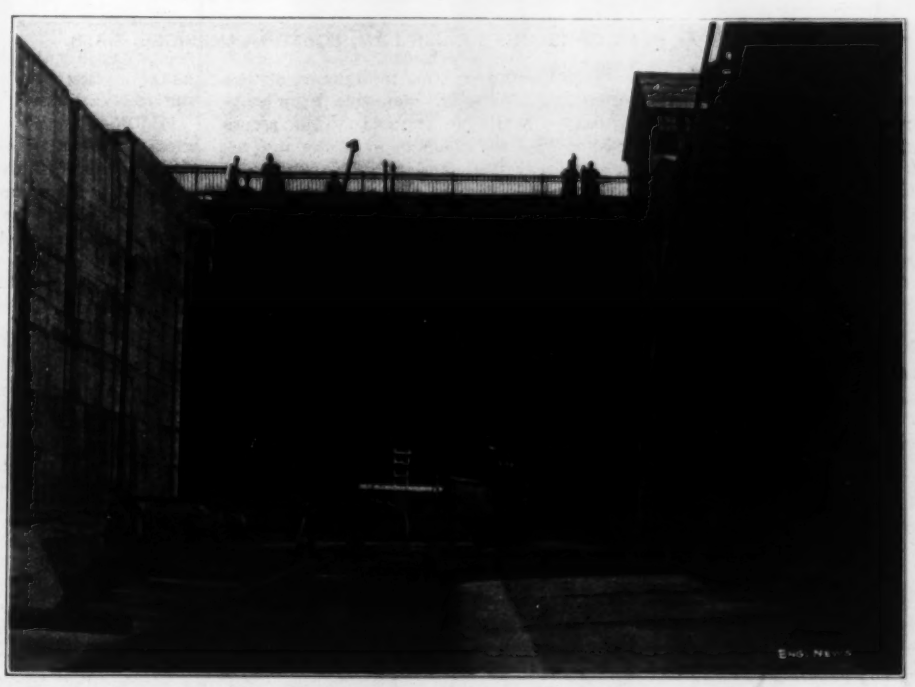
One of the first problems taken up was the study of lock-gates. After a careful investigation had been made of all the types which have been used, it was decided to build a steel caisson gate, moving on its own longitudinal axis into a recess in the lock wall. This type of gate requires less room for operation than the ordinary miter-ing gates, of which double pairs would have been necessary to take the pressures in both directions.

After the general type of gate was decided upon, the methods of supporting and moving it were considered. Three practicable methods of supporting gates of this general type have been satisfactorily employed. The caisson may be supported like a railway car upon trucks attached to its under side; it may rest upon rollers set at close intervals in the masonry under it; or it may be hung upon trucks attached to its upper part and running upon an overhead track supported upon a retractile drawbridge, which, after the gate is opened, may also be pulled back to allow the passage of masted vessels through the lock. The first method, that of supporting the gate upon trucks underneath it, seemed to offer many advantages over the others, and was adopted.



LOWER LOCK GATE OF THE CHARLES RIVER DAM, BOSTON-CAMBRIDGE, MASS.

The two gates are not alike, the down-stream one being considerably the larger. It was necessary to place the sills of this gate low enough to give a depth of 17 ft. at mean low tide, while the sills of the up-stream gate were fixed in elevation by the level of the water in the basin, which, as previously stated, is to be maintained at about 7½ ft. above mean low tide. Then, too, the top of the down-stream gate had to be high enough to keep out the highest tide which may ever be expected, while the top of the up-stream gate could be placed about 2 ft. lower, as no vessels will be locked through at the time of an excessively high tide.

Each gate is a steel structure, composed of two main horizontal girders, several main vertical girders between them, and a frame of smaller girders and beams, all covered over with the skin plates. The upper part is a double-skin gate and the lower part is a single-skin gate, except that at both ends plates are carried down on both sides to form passageways to and chambers about the trucks. The elevations of the lower gate are shown by Fig. 2, the details of the trucks by Fig. 3 and a view of the rails and rail chairs by Fig. 4.

Manholes are provided in the girder webs (Fig. 2), and there are iron ladders in the passage-ways, so that it is possible to go from the deck to the truck very easily. The intermediate compartments form air-locks. The truck chambers, open underneath and closed above, act on the diving-bell principle, so that by pumping in air at the necessary pressure, the water may be forced out and the trucks examined at any time. The depth of the water below the compressed-air surface at the bottom of the truck chambers will be only about 15 ins., so that the track, too, can be examined. This permits the recess across the bottom of the lock to be cleaned of any sediment which may accumulate in it without going through the expensive operation of putting in the stop-planks at the ends of the lock and pumping it all out. A man may stand between the axles of the truck, some 25 ft. below the level of the water outside, and may walk along as fast as the gate moves.

Under the ordinary conditions of loading on the gate, due to the pressure of the water, the vertical end girders and the horizontal bottom girder are supported throughout their length against the sills, while the other girders and beams are supported at both ends. If it is assumed that one of the gates is for some reason out of commission and withdrawn into its recess for repairs, it is still possible to open the other at times when the elevation of the tide is the same as that of the basin and to allow a vessel to pass through the lock. It may happen that, by

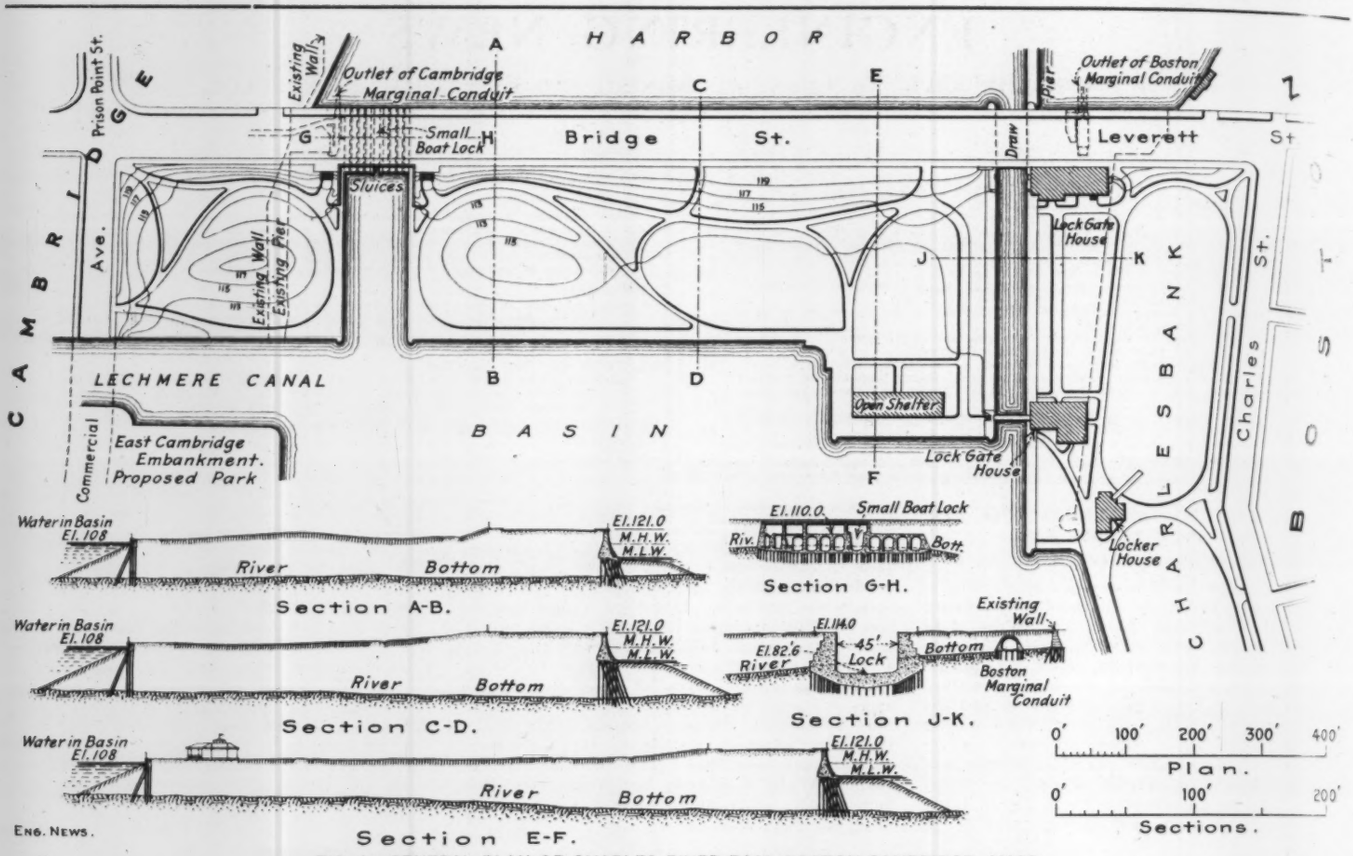


FIG. 1. GENERAL PLAN OF CHARLES RIVER DAM, BOSTON-CAMBRIDGE, MASS.

the time the vessel is through and the gate started back to its place across the lock, the tide may have fallen appreciably, and that by the time the gate is nearly closed it may have fallen enough to cause such pressures on the gate that it cannot be moved further, either to finally close it or indeed to move it in either direction, until the tide rises again to the point where the pressures on both sides of the gate are nearly equal.

This same condition may intentionally be obtained if at a time of some excessive upland flood the sluice area through the dam be found insufficient and the lock-gates left partly open while the tide falls so as to provide additional opportunity for the water in the basin to get out.

Under such conditions the top girder of the gate becomes a cantilever, supported upon suitable adjustable bearings arranged in the recess walls, and having for loads upon it the top reactions of the vertical girders. The horizontal bottom girder is, as before, supported on the sill and all the vertical girders are supported at their ends.

The possibility of having the gate hung up in this way explains the overhanging end of the top girder, while the fact that such loadings may occur with the gate in *any* position and that the reactions may consequently be applied at any points of the top girder gives the reason for the peculiar flange section which was adopted. As it was not practicable to place stiffeners at every point of application of a reaction which may act at any point of the girder, and as the reactions will be very large, a flange section was devised to satisfy the following requirements:

(1) The number of flange rivets through the girder web between stiffeners must be great enough to load the web to its full capacity.

(2) The flange must be strong enough as a beam to carry the remaining load, not taken directly by the web between stiffeners, to the stiffeners.

(3) The webs of the flange channels must be so thick that, under the maximum possible reaction, they will not buckle or crush outside the outer line of rivets.

The maximum load on the top girder of the lower gate, when supported at one end only, was found with the basin at Elev. 109.5* and the harbor at Elev. 98.8, and for this loading the front reaction was found to be 562,000 lbs. and the rear reaction 320,000 lbs., the gate being not quite closed.

Each flange consists of two 15 × 7/16-in. plates, two 15-in. 50-lb. channels, one ⅜-in. plate to support the deck over the top of the gate, and one

*Referred to a datum 100 ft. below Boston City Base.

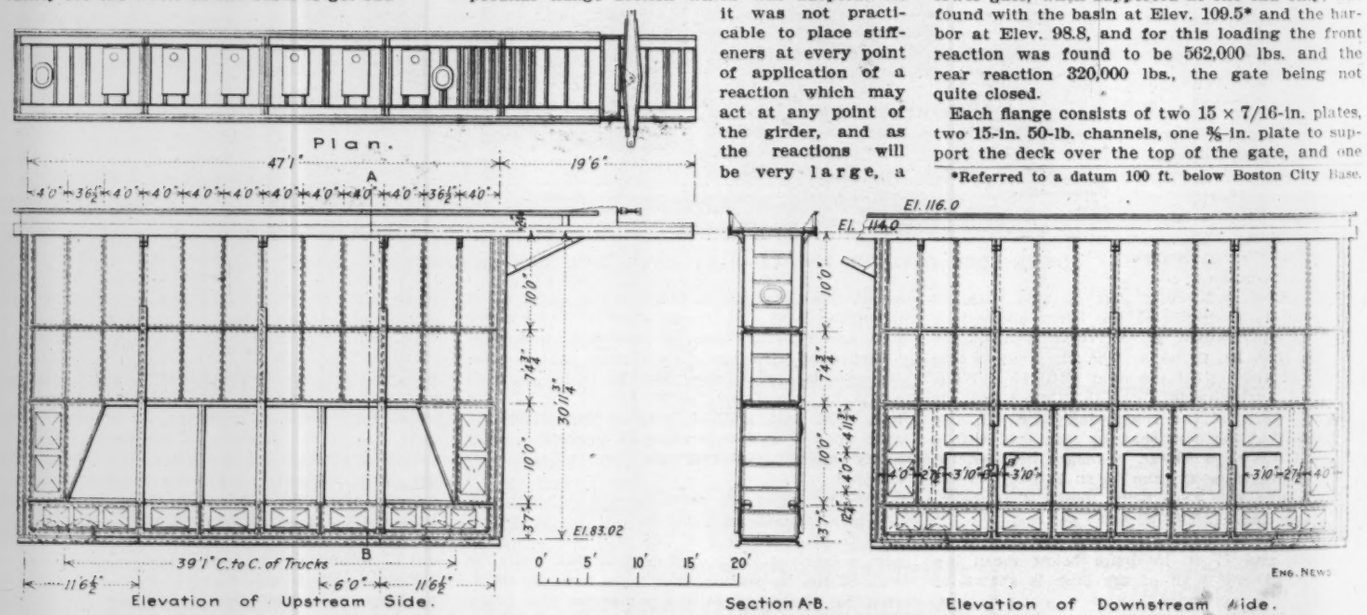


FIG. 2. ELEVATION OF THE LOWER LOCK-GATE, CHARLES RIVER DAM.

14 x ⅞-in. plate. (Fig. 5.) The channels and the 7/16-in. plates were riveted together by countersunk rivets and planed on the outside or bearing faces before being assembled on the girder, so as to insure the proper distribution of the reactions. The reactions decrease rapidly as the gate moves back into the recess, and the 7/16-in. plates were omitted as soon as the channels alone sufficed.

There are a number of wharves in the basin not far from the dam and a considerable amount of shipping will use the lock. It is required that a clear waterway be maintained from the wharves to the lock and that the lock be kept in operation at all times of the year. As the water in the basin will be fresh and frequently frozen in winter it will be necessary to use an ice-breaking tug to keep the channel open, and the broken ice will be floated down through the ice-run, which has been provided in the upper lock-gate, through the lock to the harbor.

The gates themselves will be heated internally by steam radiators, placed near the skin plates, which will give out heat enough to prevent ice from forming within a foot of the gates. The gate recesses will be kept sufficiently warm by the buildings over them, and the small recesses in the westerly lock wall are provided with heating devices. All these precautions should make it possible to keep the lock in operation continuously, in spite of the severe winters.

The heating coils in the lower gate have a radiating surface of 1,000 sq. ft. and those in the upper gate have a radiating surface of 650 sq. ft.

A boiler plant has been installed, consisting of two horizontal return tubular boilers, each 16 ft. long and 48 ins. in diameter, designed to work at a pressure of 125 lbs. per sq. in., using anthracite coal for fuel and having an induced draft. This plant will provide steam for heating the gates and the buildings over the recesses.

In connection with the design for heating the lock-gates, it was considered desirable to get more positive data than existed in any available technical literature, from which to draw conclusions as to the size of plant required and the best method of manipulation. The problem appeared to be a novel one, and as very little satisfactory information could be obtained in reference to it, experiments were made to determine, if possible, some of the doubtful factors. These experiments were described by Mr. Walton H. Sears in Engineering News of March 15, 1906.

The lock is filled and emptied by means of sluice-gates mounted upon the lock-gates. Each filling gate is operated by a 3-HP. motor on a 220-volt direct current which is controlled from the operating room. A suitable mechanism for hand operation is also provided. The several motors on each gate are controlled by a master-controlling device so arranged that any accident to an individual motor or its local circuit, or an obstruction to opening or closing any one of the gates, does not interfere with the operation of the others. Indicating devices upon the controller panels keep the operator informed of the position of the filling gates.

Studies were made of the velocities of the water in the lock due to opening the filling gates at various rates when there is a large vessel in the lock. These showed that it would be safe to arrange them to open wide in about three minutes.

In addition to the steam piping in the lock-gates, a complete system of air piping has been installed, so arranged that air may be forced into any desired compartment. Air under pressure is required to force out the water when it is necessary to go down to the trucks and it will be used also for drying out the interior of the gate for painting.

An air-compressor plant has been installed, which consists of two Westinghouse motor-driven compressors, arranged for continuous operation. This plant can supply about 92 cu. ft. of free air per min., pumping against a pressure of 100 lbs. per sq. in. The automatic governor is set so that the motors start when the pressure in the reservoirs falls to 90 lbs. and stop again when it rises to 100 lbs.

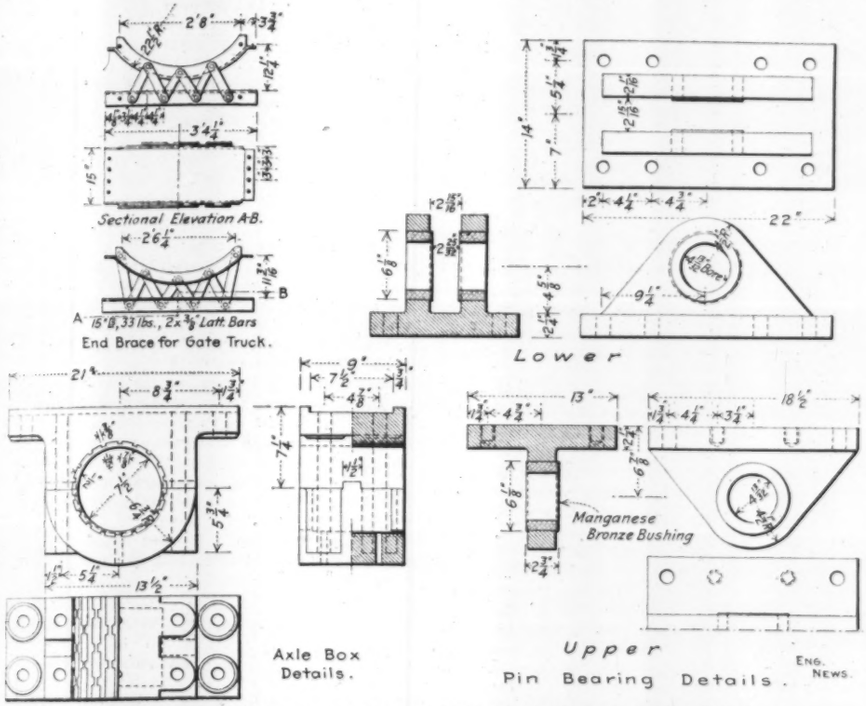


FIG. 3. DETAILS OF LOCK-GATE TRUCKS, CHARLES RIVER DAM.

Fig. 4. Gate Recess, Showing Rails and Rail Chairs, Lock-Gates of Charles River Dam.

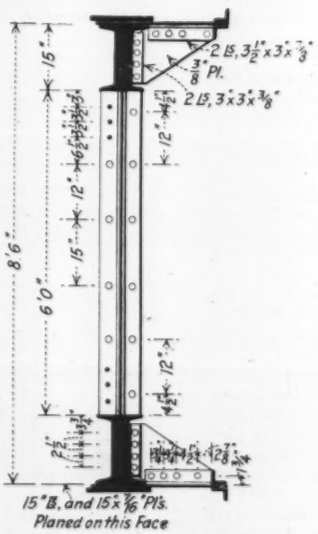


Fig. 5. Section of Top Girder of Lock-Gate, Charles River Dam.

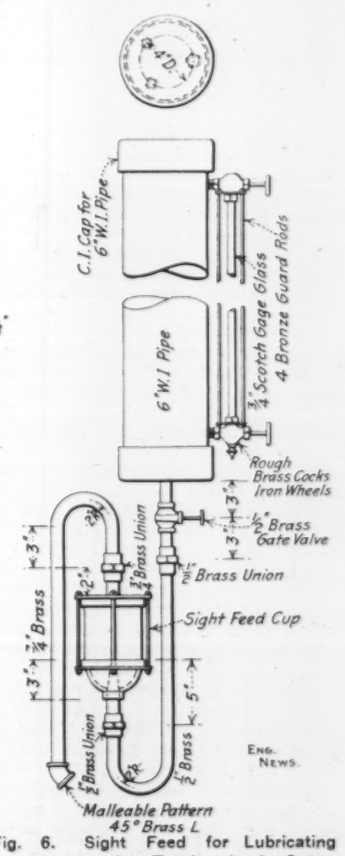


Fig. 6. Sight Feed for Lubricating System for Trucks, Lock-Gates, Charles River Dam.

The axles of the trucks (Fig. 3) which support the gate are of forged Parsons' manganese bronze. This metal was used, since, while possessing all the physical properties of medium steel, it does not deteriorate in salt water. The strength of the axles, therefore, will not decrease as would the strength of steel axles, and there will be no possibility of rust preventing them from turning easily in the boxes.

The boxes are lined with Parsons' white brass. The gates will move rather slowly, about a minute being required for opening or closing, and it is possible that the water in which they run would be sufficient lubricant. It was not considered safe to depend upon it, however, and experiments were made upon greases and oils under such low temperatures as obtain under water in Boston in winter. Greases cannot be used, as they become too hard to be forced from the cups, even when great pressure is applied. Oils can be used, but it is necessary to select those which do not readily wash out of the bearings.

The oiling system consists of oil reservoirs in the upper compartments of the gates, sight-feed cups just below the reservoirs, and small brass pipes leading down to the truck bearings. The sight-feed cups, which are filled with water through which the oil rises, are shown in Fig. 6. The oil reservoirs are connected with the compressed-air system by suitable reducing valves, so that there will always be enough pressure upon the oil to force it down to the bearings against the head of water.

Each lock-gate is operated by two endless chains driven by two 50-HP. electric motors, with suitable gearing at the rear end of the gate recess, and running over idle sprockets at the front end of the recess. These chains are attached to an equalizing beam which is connected to the gate by a steel pin, so that it may be opened or shut according to the direction in which the motors are turned.

The chains are very heavy, and to prevent sagging are supported upon steel tracks. Figs. 7 and 8 show the arrangement of the operating machinery, the chain supports and the details of the chain.

The links of the chains are of cold-rolled 40-carbon steel, having an ultimate strength of about 100,000 lbs. per sq. in.

The controllers for the lock-gates, the lock-filling gates and the drawbridge which spans the lock are all installed at present in a two-story wooden operating tower, located at the side of the lock just below the lower gate. These controllers will eventually be placed in the tower of the house which is to be built over the lower gate recess, and in a room about 40 ft. above the highest water level, so that the operator may have an unobstructed view of the gates and the drawbridge, and of the river both above and below the dam.

The devices for controlling the lock-gates are as nearly "fool proof" as they can be. The use of master controllers insures the current not being turned on too suddenly and a limit switch will prevent the possibility of a stupid operator wrecking a gate by ramming it into the opposite lock wall. When it arrives within about 2 ft. of the closed position this limit switch cuts out the current automatically, after which turning the controller one more notch will give just power enough to roll the gate gently to its seat. The master controllers for the two gates are interlocked so that it will never be possible for anyone to open both gates at the same time, causing trouble to the vessels waiting to be locked.

The air compartments in the lock-gates are so large that the gates would float up off the tracks at high tide if ballast were not put in to overcome the buoyancy. It was intended to use pig-iron laid in cement for this ballast, but it was found possible to obtain some of the old ballast from the U. S. S. Saratoga, which was broken up some time ago. This government kentlage, as it is called, is in bars about 6 ins. sq. and from 18 ins. to 3 ft. long, and has holes in the ends for convenience in handling.

Even with the ballast, the gates would still float at high tide if a certain amount of water were not allowed to enter them. This buoyancy will be taken advantage of when it becomes necessary to replace a gate. The present gates were erected in their recesses, but as these will be covered by houses, it will be impossible to assemble new ones in the same way. When it is desirable to remove one of the gates, the water ballast will be forced out, small timber caissons will be attached to the sides, and it will be floated in its normal position in the water out of the recess and towed away. In the same way, the new gate, which may be built, launched and towed to a point near the lock before the old one is removed, may then be floated into place, sunk upon the tracks and connected to the machinery ready for operation.

The structural work on the lock-gates was done by the New Jersey-West Virginia Bridge Co.; the sluice-gates for filling the lock were made by the Coffin Valve Co.; the controllers were furnished by the Cutler-Hammer Manufacturing Co.: and the operating machinery was made by the Link-Belt Co.

The Charles River Basin Commission consists of Mr. Henry D. Yerxa, Chairman; Mr. Joshua B. Holden, and Gen. Edgar R. Champlin. Mr. Hiram A. Miller, M. Am. Soc. C. E., is Chief Engineer.

ANNUAL MEETING OF THE AMERICAN SOCIETY FOR TESTING MATERIALS.

[Concluded from Eng. News, July 2, p. 25.]

Besides the papers on Iron and Steel and on Cement the other big subdivisions of subjects were Paints and Preservative Coatings and Testing Machinery. These papers and reports follow.

PAINTS AND PRESERVATIVE COATINGS.

REPORT OF THE COMMITTEE ON PRESERVATIVE COATINGS FOR IRON AND STEEL.—A continuation of the service tests on the Pennsylvania R. R. bridge over the Susquehanna River at Havre de Grace was reported. Here 19 panels had been painted with various kinds of preservative coatings. In general the report showed no marked differences in the majority of cases. The only example of an asphaltum base thinned with a petroleum volatile solvent was shown as having failed to a marked extent after 18 months' exposure. A carbon paint containing rosin, in the oil, developed fissure cracks all over the surface. The difference in the expansion of a red lead under coat and a carbon final was shown by cobweb cracks in the upper coat through which showed the red lead underneath. Pure red-lead pigments in straight raw linseed oil showed evidences of "alligatoring." A high gloss and tenacious film after exposure were shown with one panel where the pigment was iron oxide red lead and a carbon black and the vehicle was a gum varnish thinned with turpentine. There were reported slight evidences of rust on all sections of the bridge, due to mechanical injury to the coatings.

This committee discussed the need of accelerated preliminary tests to give indications of the value of coatings. It was stated that this should be approached by investigating the causes of destruction, the function of both pigment and vehicle and changes during setting.

Negotiations were reported from the Bureau of Promotion and Development of the Paint Manufacturers' Association of the United States, as a result of which the reporting committee undertook the supervision of the application and service inspections of several coatings supplied. The committee held that it was not responsible for the results, as the paints had been prepared on the paint makers' formulas and ground in special oils or japans by them, nor was it able to draw conclusions from the results of exposure.

In accordance with these arrangements a fence had been erected near Atlantic City on which the carefully selected and painted wooden panels had been fastened. Similar tests are being made at Fargo, North Dakota, and at Pittsburg, Pa.

SOLUBILITY TESTS OF PROTECTIVE COATINGS.—Mr. G. W. Thompson, in this paper, described what might be called accelerated laboratory tests on paints. Essentially the method consisted of dipping strips of antiseptic gauze, 18 to 24 ins. long, in the paint to

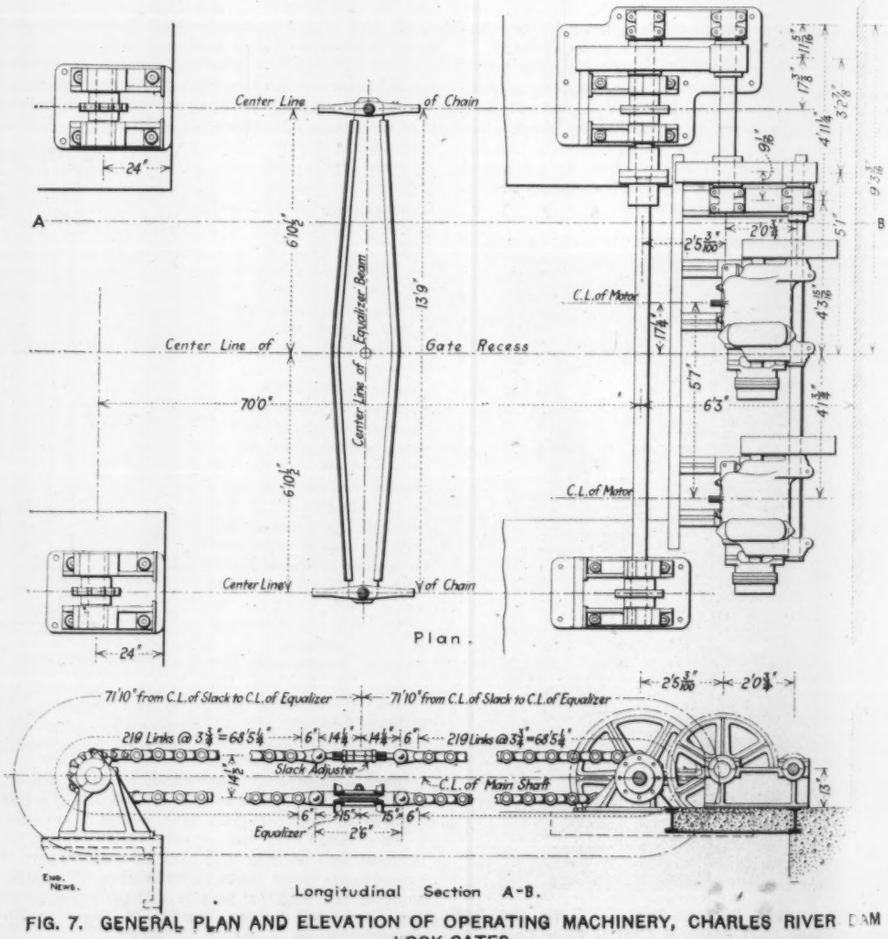


FIG. 7. GENERAL PLAN AND ELEVATION OF OPERATING MACHINERY, CHARLES RIVER DAM LOCK-GATES.

be examined and removing, by rolling, the excess over that the suspended strips could easily carry. These were put on clock glasses and weighed at intervals as the setting proceeded. After setting had completed they were treated with distilled water and again weighed from time to time. The solvency of the coating was taken as an index of its weathering qualities.

THE ANALYSIS OF VARNISHES.—This paper, by Mr. P. C. McIlhiney, was of greatest interest to chemists and outlined the development of laboratory processes by which the amount of dryer, fine gum, rosin and the different oils might be ascertained. Heretofore the varnish makers have considered it impossible to find the amounts of the fine gums, rosins and oils that had been digested into varnish at a comparatively high temperature. As the proportions of the better gums and oils determines the serviceability of the varnish such an analysis may be taken as an indication of what might be expected in actual use.

The discussion of all the papers on paints took the form of more or less personal encounters between the interests in favor of "pure-paint" legislation and those opposed to it. These discussions were not technical, or at best only slightly of engineering interest.

TESTING APPARATUS AND METHODS.

THE USE OF THE EXTENSOMETER IN COMMERCIAL WORK.—The title of this paper, by Mr. T. D. Lynch, is somewhat misleading. The main object of the paper seemed to be the presentation of several groups of stress-strain figures from the records of work carried on by the Westinghouse Electric and Manufacturing Co., at East Pittsburg, Pa. The tests were made in a 100,000-lb. testing machine with an Ewing extensometer reading to 0.00008-in., in 1.25 ins.

FEATURES OF RECENT 600,000-LB. UNIVERSAL TESTING MACHINE.—Mr. T. Y. Olsen (Philadelphia, Pa.) in this paper set forth many details of construction of three of these large machines. One is now at the Structural Materials Laboratory of the United States Geological Survey, St. Louis, Mo.; the second is at the University of Pennsylvania; the third is nearing completion for the Rensselaer Polytechnic Institute, Troy, N. Y. In general these machines have four pulling screws which do not revolve but are drawn down by rotating nuts in the base. There are special guide columns, for the traveling crosshead, to better resist side stresses. A device for receiving the effect of the recoil, after rupture of specimens under heavy loading, to protect the lever system was also mentioned.

NEW FORMS OF TESTING MACHINES, PENDULUM TYPE.—The author of the previous paper also presented descriptions of two forms of tension machines; one for textile and the other for wire work. In the first of these a simple straining mechanism has been provided with a gripping carriage moved by a screw and hand wheel. The weighing mechanism is essentially a counterweighted pendulum swinging in ball bearings. When a load of about 12 lbs. is secured the pendelum engages with the counterweight which therefore becomes a part of the pendulum. Now a load up to 200 lbs. can be secured and weighed by moving the gripping carriage. The weight is indicated on a circular graduated arc by a slide bar.

The second machine described reads to 1,200 lbs., maximum loading, and seems to differ from the one first described in having merely a heavy unbalanced pendulum which is drawn from the vertical.

AN AUTOGRAPHIC RECORDER FOR RAPID TENSION TESTING.—In this paper, Mr. H. F. Moore objected to the common forms of autographic attachments largely on account of their slowness and uneven action. A form of autographic attachment was described which had been used with claimed success in the laboratories of the University of Illinois. A steam-engine indicator was used to record stress and elongation, the spring of the indicator being attached to the beam and the drum to the pulling head. A rod was placed with one end in a center on the rear end of the beam and with the other end bearing against the center of the indicator piston. The poise on the machine was to be run out until the indicator spring was compressed enough to force the pencil leg of the parallel motion to the top of the card. The poise was then to be locked in place. As load came on the specimen instead of moving the poise to preserve equilibrium the beam was allowed to move. Such a movement decreased the load on the spring which elongated until equilibrium was established. The elongation of the spring and the consequent travel of the pencil point were taken as proportional to the load applied. The amount of rotation of the indicator drum gave the elongation, neglecting the slip of the specimen in the grips. The author admitted, however, that this slip would show very inaccurately the small elongations within the yield point of a specimen. Beyond this he claimed that the stretch of the specimen would be so greatly increased that no serious error would be introduced. As an indication of the possible accuracy of the method the following tests were quoted. All samples were from a single piece of soft steel rod.

	Autographic.		Drop of Beam.	
	Test 1.	Test 2.	Test 3.	Test 4.
Load at yield point, lbs.	7,790	7,970	8,260	8,030
Unit stress at yield point, lbs. per sq. in.	38,000	38,900	40,300	39,300
Ultimate load	12,400	12,400	12,670	12,690
Unit stress at ultimate load	60,500	60,500	61,700	61,900

FOREST SERVICE TESTS OF TIMBER.—Under the general topic of "Tests to Determine the Influence of Methods and Rates of Loading on the Strength and Stiffness of Timber" were two papers. The first, by Mr. McGarvey Cline, was on the "Purpose and Scope of the Investigations." In this the statement was made that the Forest Service tests were being made on three lines: (1) to determine the relation between strength and rates of loading in the ordinary universal testing machine; (2) to determine the strength of timber under a continued dead load; (3) to determine resistance to impact.

The first of these groups of tests was carried out by Mr. H. D. Tiemann at the Yale Forest School, and the methods and results were presented later in his paper.

The apparatus for the second group of tests was put in place at the Yale Forest School. Essentially, it may be said, that the load was applied through weighted levers, the deflections being recorded on an automatic clockwork-driven drum. It was necessary to magnify the deflections in recording them. These experiments are under way and no results and conclusions are as yet available.

The impact tests made up to recently have been on a machine described in Vol. VI., Proceedings of this Society. It was found, however, that it was not adapted to investigating action under repetitive impact loading and data secured with it were with difficulty compared with tests for dead and gradually applied loads.

A new impact machine has now been designed for the Forest Service Laboratory at the University of Washington in Seattle. This is to be a heavy machine set on a massive concrete foundation. The distance between guide columns is 19 ins. and from base to top of columns is 8 ft. A hammer is to be raised through a magnetic clutch which is fitted with a current-reversing switch to insure a quick release of the hammer at any desired point. This ham-

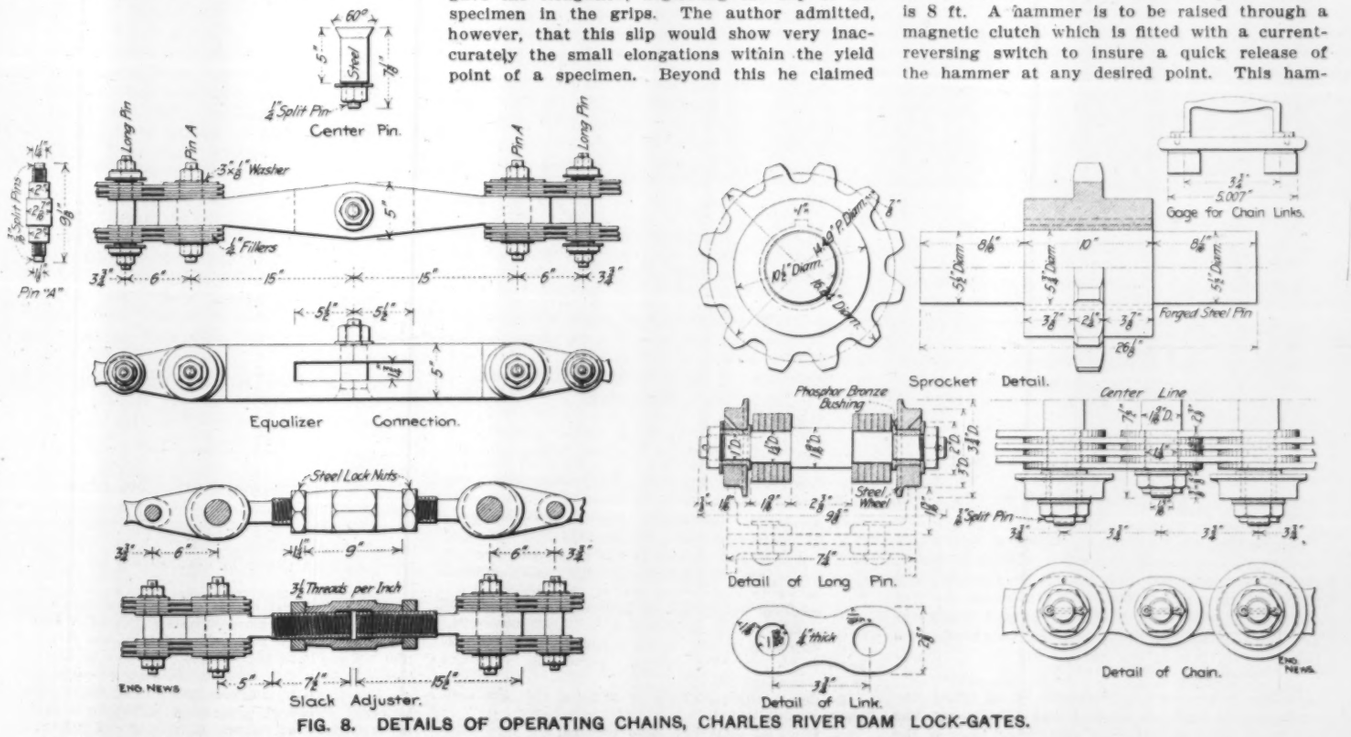


FIG. 8. DETAILS OF OPERATING CHAINS, CHARLES RIVER DAM LOCK-GATES.

mer weight may be varied from 500 to 1,500 lbs. The action is to be entirely automatic for repeating a certain blow or automatically increasing the force. A recording drum registers all deflections, rebounds, etc.

In the second paper on this general subject, Mr. Tiemann first briefly reviewed the grounds for believing that the speed of loading had an appreciable effect on the data resulting from the test. In the theoretical considerations "rate of strain" was taken as a basis for deductions rather than "rate of stress," as the former could be controlled by the testing machine while the latter was quite circumstantial. To obtain comparable deductions, proportional change in speed and proportional change in strength were used rather than actual or absolute values. A "Speed-Strength Modulus," T, was deduced as;

$$T = \frac{\frac{d\,L}{L}}{\frac{d\,V}{V}} = \frac{d\,(\log L)}{d\,(\log V)}$$

where strength is denoted by L and speed by V.

If the proportional change in speed be multiplied by this modulus, it will give the proportional change in strength at any given speed.

Tests were made on beams 2 × 2 ins. in section with a 36-in. span, center loading and on compression members of the same section 5¾ ins. long, loaded parallel to the grain. A range of speeds of 1 to 150 for compression and 1 to 500 for beams was obtained. The material was longleaf pine, red spruce and chestnut; green and kiln dried.

The results showed a notable change in strength increasing with increased speed of loading. The green specimens invariably showed a greater change in strength than the dry and a remarkable correspondence was manifest between the ratios, moisture-strength and speed-strength. From the tests quoted it would seem that ordinarily 50% change in speed of applying a testing load would produce a 2% variation in the actual load and that a variation up to this amount may pass uncorrected. On account of brittleness of the material the rate of increase of fiber stress was recommended to be kept below 0.0025-in. per min. in beams and of 0.015 for columns.

OTHER TECHNICAL PAPERS.

Mr. W. A. Aiken (New York), in a paper entitled "Testing Not Inspection," emphasized the inherent nature of a true inspection and showed wherein it differed from mere testing. Inspection is required by engineers in order that the quality of the material which goes into the structure may be in equally as high a standard as the design and construction. These three go together to make the perfect engineering whole. However, it is often assumed that the occasional physical test of a portion of the material is an inspection of the entire material when in reality it is merely in the form of insurance against possible failure. If a portion of the material answers the tests it is probable, but not certain, that the rest will. Therefore, in inspection, testing is only a small part, but in order that it serve its purpose it should be taken on pieces which are representative of the material, of all the material and which are a fair proportion of all of the material.

Mr. R. S. Greenman (Albany, N. Y.) presented a paper on "The Acceptance of Stone for Use on Roads Based on Standard Tests," in which he explained that in building the $50,000,000 worth of roads decided upon for New York State, the State Engineer's office have opened a laboratory similar to the one in the office of Public Roads at Washington, and that the tests standardized at the latter laboratory are being successfully applied, except that contractors and engineers are loath to accept the cementing value of stone as given in laboratory tests. Mr. A. S. Cushman (Washington, D. C.) said that these cementing value tests promise to be of great importance, though at present the laboratory has not been able to discover any fixed law in the cementing power of rock. It is hoped, however, that in the near future some uniformity in cementing power will be discovered and the knowledge applied to the selection of work for roads.

STRUCTURAL TIMBERS OF THE PACIFIC COAST.—Mr. R. Thelen (U. S. Forest Service) said, in a paper with the above title, that the rapid disappearance of eastern timbers of known properties had caused an investigation of the western structural timbers, principal among which is the Douglas fir, now having a stumpage of 350 million feet. The next largest stumpage for any wood below this is Southern yellow pine at about a billion feet less. In tests on Douglas fir the Forest Service have found that in flexure the elastic limit for this wood will run about 4,370 lbs. per sq. in. for selects, 4,000 for merchantable and 3,500 for seconds. These tests are large green specimens, because seasoning causes loss of moisture and checking, thereby reducing strength. In these tests it was also found that in knotty pieces tested with the knots in tension and in compression, the comparison with several pieces was as follows:

Defects in tension side	80%
Defects in compression side	92.5%
No defects	100%

It was also found that there was no appreciable difference in the structural quality of the red and yellow varieties of Douglas fir.

Three other governmental reports were presented. The first, by Mr. H. M. Wilson (Chief Engineer, Technologic Branch, U. S. Geological Survey) recounted, what has been described before in this journal, the various work now being carried on in a testing line by his bureau. Mr. J. E. Woodwell (U. S. Treasury Dept.) renewed his account of last year, describing the methods and extent of the testing of coal for purchase by the U. S. Government. He said that the practice is growing to all the various branches of governmental service and that besides getting better coal for the government dealers themselves are rapidly being convinced of the fairness and desirability of the process. Mr. R. L. Humphrey (U. S. Geological Survey) delivered his annual address on the progress of the work at the Structural Materials Testing Laboratories at St. Louis.

STEEL COLUMN TESTS AT WATERTOWN ARSENAL.—In view of the general desire for a more complete knowledge of the behavior of steel columns under load, which has been one of the results of the Quebec Bridge disaster, the government has authorized an increased appropriation to be devoted to steel column tests at Watertown Arsenal. The program of these tests was decided on by a board of engineers and was reported at this meeting. Briefly the plan of procedure was as follows:

(1) Begin with a series of "standard tests," on members of rolled and built sections, designed and manufactured according to the best methods of current practice, to be tested for central loading.

(2) Develop the program for a series of "special tests" under eccentric loading, and variations in design and manufacture only to a sufficient extent to fix the number of members to be treated, their length and section.

Accordingly the projected tests were started for 703 members of the following general type and all of a size to permit them to be tested in the 700,000-lb., 26-ft. machine at Watertown.

(a) Annular section (welded tubes).
(b) New wide-flange H-sections.
(c) I-section of four angles and central web-plate.
(d) Double-channel section; latticed in two planes.

In the "special tests" the following points are to be observed:

(a) Eccentricity of loading due to (1) shifting of pins, (2) bearings beveled in direction of either principal axis of section, and inclined in like or opposte direction at both ends, and (3) unsymmetrcal distribution of rivets with respect to longitudinal axis of members.

(b) Columns lightly spliced at center with imperfect end contact.

(c) Efficiency of end batten plates and latticing; especially for eccentric loading, introducing variations in size, spacing, etc.

(d) Comparative efficiency of latticing and intermediate batten plates.

(e) Effect of tight and loose riveting.

(f) Effect of weight of piece in the absence of counterbalancing.

(g) Effect of sub-punching and reaming and of drilling rivet holes from the solid.

(h) Effect of ends partially fixed by riveted connections, and of round ends.

So far the only tests that have been made were on the tubes and the H-columns. These were reported by Mr. J. E. Howard, but as they are quite similar to like tests made in the past and are chiefly valuable as the preliminary results from an extensive series, they will not be described here.

BRICKS AND THE ADHESION OF MORTAR. Mr. D. E. Douty (Washington, D. C.) presented a paper entitled "The Influence of the Absorptive Capacity of Bricks upon the Adhesion of Mortar," which represented the work of a preliminary set of tests which are now being carried out by the U. S. Bureau of Standards. The results show that the adhesion increases as the porosity, but the results are not in very good accord, due perhaps to the methods of testing which, as arranged, are capable of much improvement.

THE DESIRABILITY OF STANDARD SPECIFICATIONS FOR HARD DRAWN COPPER WIRE.—Messrs. J. A. Capp and W. H. Bassett made a brief plea for uniformity in specifications for wire which was to be used for long spans, such as in electric power transmission. They cited several examples where the engineers' demands were extremely variable. For instance, one specification quoted required a tensile strength of not less than 60,000 lbs. per sq. in., with an elongation of 1% in 10 ins., and an elastic limit of not less than 35,000 lbs. per sq. in.; these requirements applying to all sizes of wire which the company desired to purchase. In a second specification covering similar sizes a minimum tensile strength of 62,000 lbs. per sq. in., with a minimum elongation of 1.14% in 60 ins., was demanded. One specification cited requires the same tensile strength regardless of size and another demands an increase in strength uniform with the decrease in diameter. The tensile strength of hard drawn copper wire is greatly influenced by the actual reduction in section during the drawing process. The elongation of the wire, under test, however, must decrease with the amount of cold drawing and the specifications must be a compromise between maximum tensile strength and maximum elongation. It was stated in respect to the requirements for twisting and wrapping that the results varied so greatly with the way in which the test was made that unless all conditions were carefully defined and observed the results were valueless. The electrical conductivity was held to be the most nearly fixed of all the characteristics, and even this had a wide range in existing specifications.

The authors expressed the hope that a decimal gage could be adopted, as at present there were in use three distinct wire gages with some special modifications of these. In the discussion of this paper it appeared that some of the larger manufacturing concerns were using a decimal gage on all "interior" orders, although such could not obtain for work and material outside their plant.

The convention referred this matter to the Executive Committee of the Society, with the recommendation that a Committee on Specifications for Hard Drawn Copper Wire be appointed.

MANGANESE BRONZE.—The properties of this alloy—said to be the only copper alloy whose metallurgy has been adequately worked out—were described by Mr. C. R. Spare. The trend of this paper is best shown by a few excerpts.

There are several brands of manganese bronze on the market, each with its own characteristics which are determined by chemical composition and process of manufacture. While upon analysis some of these bronzes do not reveal striking differences in composition, yet the alloys are susceptible of wide variations in physical properties by slight changes in composition, difference in quality of raw materials and methods of melting and mixing.

There is no metal of equal strength and toughness which will produce such sound, smooth, intricate castings, true to the form of the pattern. It is practically incorrodible in sea and alkali waters. Test pieces cut from cast propellers should show an average ultimate tensile strength of 70,000 lbs. per sq. in., elastic limit of about 35,000 lbs., elongation in 2 ins. 25% and a reduction in area of 25%. A soft maganese bronze can be made with an ultimate strength of 60,000 lbs. per sq. in. with 40 or 50% elongation in 2 ins. An exceedingly hard manganese bronze can be made to test over 90,000 lbs. per sq. in., with a 20% elongation. In compression cast manganese bronze, properly made, shows an average elastic limit of 35,000 to 40,000 lbs. per sq. in., and a maximum crushing load of 80,000 to 100,000 lbs. Rolled or forged samples test 50,000 to 60,000 lbs. elastic limit, and show a crushing strength as high as 130,000 to 150,000 lbs.

Manganese bronze can be rolled or forged readily at a red heat with the production of an exceedingly tough, dense and close grained metal. Rolling or forging raises the proportional elastic limit to from 45,000 to 75,000 lbs. per sq. in., depending upon the finishing temperature and the amount of work done on the metal. The ductility and toughness are likewise increased without, however, a corresponding increase in ultimate strength. Forged and rolled rods find a wide application as piston rods, shafts, axles and for all purposes where a metal of a strength and toughness equal to carbon steel is desired, and one which will not rust or corrode in the atmosphere or in mine or sea water.

An especially soft and tough metal is made to resist vibratory and sudden stresses and shocks. It is used under severe conditions in naval ordnance and for staybolts in locomotives. This bronze tests with 40 to 50% elongation and some 60% reduction of area.

It is not the purpose of this paper to explain the theory or outline the history of the deoxidation of copper by manganese. It has only been attempted to outline the growing application of these alloys and to present a general idea of results of physical tests obtained by several Government and private laboratories.

In the discussion of this paper Mr. Spare gave a typical analysis of manganese bronze as, copper 55%, zinc 40% tin 1%, iron and manganese in varying proportions for the remainder.

UNIFORMITY IN MAGNETIC TESTING AND IN SPECIFICATIONS OF MAGNETIC PROPERTIES.—Mr. C. W. Burrows, of the United States Bureau of Standards, in this paper dwelled on the wide limits of variation in present methods and specifications and on the need for securing uniformity in magnetic treatment during the test, for securing uniform conditions under which the induction is to be measured, for limits of induction in hysteresis loops and for uniform size of specimens. The methods of the Bureau of Standards were shown as a suggestion as to how this desirable end might be brought about.

On account of lack of space we will have to note the following papers by title only: "Characteristic Results of Endurance Tests on Wrought Iron, Steel and Alloys," by Mr. Henry Souther; "Tests of Staybolts," by Prof. E. L. Hancock; "Effect of Combined Stresses on the Elastic Properties of Steel," Prof. E. L. Hancock.

OTHER COMMITTEE REPORTS.

COMMITTEE B: ON STANDARD SPECIFICATIONS FOR CAST IRON AND FINISHED CASTINGS.—Chairman, Mr. Walter Wood.—The committee reported the adoption in toto of their Standard Specifications on Cast Iron Pipe by the American Water-Works Association. They also requested the association to act on a resolution of the American Foundrymen's Association which asked cooperation from the American Society for Testing Materials in an effort to change the standard of selection of foundry pig iron from the present grade number to a chemical analysis. The cooperation of the committee was ordered by the association.

COMMITTEE H: ON STANDARD TESTS FOR ROAD MATERIALS.—Chairman, Mr. L. W. Page.—No new specifications were presented this year, but the old standard abrasion and toughness tests which have been recommended practice for several years were adopted to be sent to letter-ballot.

COMMITTEE Q: ON STANDARD SPECIFICATIONS FOR THE GRADING OF STRUCTURAL TIMBER.—Secretary reporting, Prof. W. K. Hatt.—The committee reported that the specifications had been adopted by several other societies. Only a progress report for the present year was made.

COMMITTEE R: ON UNIFORM BOILER SPECIFICATIONS.—It was reported that the test of present specifications limited the percentage of phosphorus to 0.06 and 0.04 for acid and basic steel respectively; for fire-box steel these figures are 0.04 and 0.03; for extra soft steel 0.04 in both classes. The percentages of sulphur in these three kinds of plate are limited to 0.05, 0.04 and 0.04 respectively. The committee recommended that no plate be allowed to go into a boiler which had more than 0.04 phosphorous or more than 0.03 sulphur. The recommendations were referred to the Committee on Standard Specifications for Iron and Steel.

COMMITTEES: ON WATERPROOFING.—The section on waterproofing materials other than a bituminous nature report that while many of the so-called waterproofing compounds, internally mixed, give an appreciably increased impermeability at first, the condition is only an accelerated one and would naturally occur in time when the interstices of the concrete begin to fill up from the material washed in by the external moisture. They still hold that a well-mixed concrete of graded material is the best protection against moisture. The use of colloidal clay is recommended, but the tests with electrolytes did not prove so successful. As a whole the committee reports progress.

COMMITTEE P: ON FIREPROOFING.—The committee recommended some minor changes in the "Standard Test for Fireproof Floor Construction" and a new "Test for Fireproof Partitions," both of which were approved and sent to letter ballot.

COMMITTEE T: ON STEEL SPRINGS.—Chairman, Mr. J. A. Kinkead.—The report of the committee contained two important features, as follows:

One interesting point clearly shown is that the modulus of elasticity in steel springs bears no close relation to the elastic limit. As the modulus bears a direct relation to the deflection under a given load, it is clear that the stiffness or deflection under a given load cannot be changed by hard or soft tempering. Likewise that the use of any alloy steels whatsoever, which all tend to increase the elastic limit, cannot result in a material reduction in the number of plates (weight of the spring), for although the elastic limit may be 50 or 100% greater than with the ordinary spring steel, duplicate springs will act alike under equal loads. On the other hand, the alloy steels with the resulting high elastic limit should give much longer service, as with the same fiber stress the load in proportion to the elastic limit is materially less in the alloy steels.

The difference in elastic limit, due to the difference of heat treatment in the above tests brought up the question as to what fiber stress would be most satisfactory in springs. In transverse tests or soft tempered spring plates it is found that 375,000 to 400,000 lbs. per sq. in. fibers stress, the exact stress not having been determined and which point like the modulus, seems not to be affected by the elastic limit, the plate fails without breaking, that is, it bends indefinitely under this load. It would seem reasonable to suppose, then, that the highest elastic limit that could be obtained and still permit the steel to bend to the point of failure without breaking, would give the best spring. On the other hand, a soft annealed iron wire will stand many more alternate bends beyond the elastic limit, than will a hard wire.

The second point of interest is the investigation into the effect of banding, which was brought out by an investigation into the cause of excessive failures of driving springs on one of our large railroads. On a visit to the spring shop of this road, the excessive difference in camber between the successive plates was noticed. It was at once apparent that when this excess camber was taken up in banding, a negative strain was put on the main plate which would be given an extra camber, and an equal positive strain on the short plates which would be straightened out. If the take-up was excessive or the spring very stiff, this strain could easily amount to an excess load of 30% or 24,000 lbs. per sq. in. fiber stress. The excess load the spring is always subject to in service should then result in heavy failures of the short plates. Railroad men who have investigated spring failures will recognize this condition. One road on checking this condition found an average of five failures of short plates to one of the main plates.

The remaining committees merely reported progress.

STATISTICS OF RAILWAYS OF THE UNITED STATES IN 1907.

"Poor's Manual," the well-known annual publication on American railway finances, is issued this year some two months earlier than in any previous year. From advance sheets furnished us, we glean the following statistics:

The total mileage of the steam railroads of the United States on Dec. 31, 1907, was 228,128 miles, as against 222,766 miles on Dec. 31, 1906, showng an increase of 5,362 miles.

The following table shows assets and liabilities of all the steam railroads of the United States at the close of 1907:

	1907.	1906.
Capital stock	$7,458,126,785	$7,106,408,976
Bonded debt	8,228,245,257	7,851,107,778
Other bond obligations	815,041,027	636,032,203
Accrued liabilities	94,938,347	86,218,524
Miscellaneous liabilities	75,450,828	124,319,942
Bills payable & credit accts	857,734,167	722,023,502
Sinking funds, etc	239,727,545	242,256,471
Profit and loss	789,617,481	686,919,232
Total liabilities	$18,558,881,437	$17,455,286,628
Cost R. R. and equipment	$13,364,275,191	$12,719,736,342
Stocks and bonds owned	2,884,031,173	2,544,368,852
R. estate & other invest's.	738,843,199	761,413,476
Cash, bills rec. & cred. ac.	979,730,908	941,399,320
Materials and supplies	224,237,534	182,635,253
Other assets	208,171,082	128,591,899
Sinking funds	159,592,350	177,141,525
Totals assets	$18,558,881,437	$17,455,286,628

Gross earnings of the railroads reporting earnings for 1907, embracing 225,227 miles, amounted to $2,602,757,503, as compared with $2,346,640,286 in 1906, showing an increase of $256,117,217, or nearly 11%. Net earnings from operation in 1907 were $833,839,600, as against $790,187,712 in 1906, showing an increase of $43,651,888, or about 5½%. In 1906 net earnings had shown an increase of more than 15%.

The following table shows the income account of the American railway system for the year 1907, as compared with 1906:

	1907.	1906.
Miles of R. R. operated	225,227.23	220,633.33
	$	$
Passenger	574,718,578	521,231,337
Freight	1,825,061,858	1,659,925,643
Other	202,977,067	165,483,306
Total gross earnings	2,602,757,503	2,346,640,286
Operating expenses	1,769,417,903	1,556,452,574
Net earnings	833,339,600	790,187,712
Other receipts	128,015,081	100,292,369
Total net income	961,354,681	890,480,081
Taxes	74,253,245	68,169,833
Interest on bonds	280,931,001	269,926,395
Other interest	23,759,329	13,107,169
Dividends on stock	247,258,219	225,601,245
Miscellaneous	75,176,725	79,806,024
Rentals—Interest	38,188,406	39,612,179
Dividends	31,087,374	27,739,680
Miscellaneous	18,127,456	15,042,783
Total payments	$788,781,755	$739,005,308
Surplus	172,572,926	151,474,773
Miles of R. R. operated	225,227	220,633
Revenue train mileage:		
Passenger	$511,579,317	$488,554,209
Freight	645,447,465	608,324,539
Mixed	27,211,527	27,711,651
Total	$1,184,238,309	$1,124,590,399
Passengers carried	885,724,314	815,774,118
Passenger mileage	28,370,247,819	25,842,462,029
Revenue per pass.-mile	2.040 cents	2.011 cents
Tons freight moved	1,722,210,281	1,610,099,829
Freight mileage	233,137,507,807	216,653,795,696
Revenue per ton-mile	0.782 cent	0.766 cent

THE "HELION" INCANDESCENT-LAMP filament was shown in a new development by the inventors, Professor Herschel C. Parker and Mr. W. G. Clark, of New York City, at the recent convention of the American Institute of Electrical Engineers at Atlantic City. The earlier forms of this lamp and filament were described in Engineering News, July 25, 1907. The present filament can be burned in air although the efficiency of light production is somewhat better in a vacuum. The filament is prepared much as before, by depositing a silicon composition on a carbon core; in its present form it is in comparison to an ordinary carbon filament, very coarse. As its specific resistance is stated to be some 50 times that of carbon the length required for an ordinary system voltage is comparatively short. The lamp exhibited had the filament mechanically held in copper clips from which fact it may be inferred that the old difficulty of cementing the "Helion" composition to leading-in wires has not been obviated.

THE BREAK IN THE CORNWALL, ONT., CANAL AND THE CONSEQUENT DRAWBRIDGE COLLAPSE.

The Cornwall Canal, a portion of the Canadian system of canals bordering the River St. Lawrence, starts at Cornwall, Ont., about 60 miles west of Montreal, and enters the river again at Dickinson, about 12 miles farther west. At Cornwall, some 200 yds. west of the entering locks, the line of the New York & Ottawa R. R., now a subsidiary road of the New York Central, crosses the river and the canal at nearly right angles, on a bridge which consists of three 368-ft. Pratt trusses across the American channel, a series of plate girder spans across an island in the river, an 840-ft. cantilever across the Canadian channel and a 240-ft. draw-span across the canal. On June 23, 1908, a leak developed in the river wall of the canal, immediately next to the bearing pier of the draw-span and soon developed into a large break, tearing out the canal bank for a distance of some 160 ft. and overturning the bearing pier with its draw-span, both of which were completely wrecked. In view of the rather unfortunate history of the bridge, to which this accident adds a chapter, and of the important work of repairing the break in a short time, the story of the collapse and repairs should be of great interest to the profession.

The Cornwall Canal was first built for a 9-ft. depth in the middle of the last century, but about 1896 was enlarged to its present 16-ft. depth and 95-ft. width. At the site of the bridge it follows the line of the river, being separated therefrom only by the canal bank, of the general section shown in Fig. 1. This bank was originally partly the river bank and partly the fill thrown up from the canal cut. In the first prism the canal side of the slope was of puddled clay, but in the enlargement this layer of puddle was removed and the new slope left just as it had originally been in the bank. There has been some trouble experienced in this wall heretofore and in order to render it more stable the heavy stone pavement shown in the half-tones and in the section were placed on the lower slope of the outside of the wall. The paving consists of 3 ft. stone blocks on about 1 ft. of crushed stone, held about every 60 ft. along the river by heavy cribwork boxes, running well up into the pavement.

That portion of the bridge which is across the Canadian channel consists of the large 840-ft. cantilever resting on four piers and a 240-ft. draw-span resting on a pier, which was founded, as shown in the section, in the slope of the outside canal bank, so far as the records show, about 2 ft. below the bottom level of the canal. This pier was built about two years after the enlargement of the canal and, therefore, must have had its excavation made in the finished bank. It was about 47 ft. high, plumb and 25 ft. in diameter, built of ashlar masonry backed by concrete and founded on a supposedly good hardpan with a slightly spread concrete base. As this foundation enters considerably into the history of the entire bridge, a further description will be reserved until later.

The drawbridge itself was a circular drum-bearing swing bridge of 240 ft. span made up of a central panel of 16 ft. 6 ins. and four outside panels of 27 ft. 11¼ ins. on each side. It was 28 ft. deep and 17 ft. wide to carry a single track railway. The compression and alternate members were all double lattice channels and the purely tension members of eye-bars. One peculiarity of the span was that normally it was left open, at right angles to the line of the main bridge, because the traffic in the canal is much greater than that across the bridge. The open bridge was supported by two cribs on each side, making five supports, including the center pier. In the drawing in Fig. 1, one of these supporting cribs, which was washed out in the break, is not shown.

The break was first discovered on the morning of June 23, about 6 a. m., by a passing canal employee. At that time it was a small leak just west of the draw pier, but before any safety measures could be taken, in fact in 15 minutes, the water had washed through a large section of the canal wall and overturned the pier, carrying down with it the draw-span, which at the time was in its normal open position. All of the supervising officials of the canal were at distant points along its line, so that no guided effort was effectively made to shut off the water. On account of this and on account of leaky valves in the nearest locks, the water continued its tearing action on the bank for some 24 hours, before divers finally stopped up all valves. Meanwhile the bank for a distance of about 160 ft. had been completely ripped out, together with the stone paving, timber cribs and earth wall, and the water, partially dammed by the bridge debris, had torn back into the canal bottom for a considerable distance. This condition is well shown in Figs. 2 and 4, taken during the first day. Fortunately, no boats were in the level at the time of the collapse and, so far as can discover, no one was injured in the accident.

The draw pier is now laying in four pieces, having sheared off along three joints between the ashlar facing stone. The bottom has completely left its base on the clay, as evidenced by the foot thickness of clay showing on the bottom face of the pier prominent in the foreground of Fig. 4. The span itself was thrown to the west about 50 ft. by the falling pier and broke, as shown, upon the west resting-crib and the center pier. The steel in the draw-span did not show up very well in the collapse, although the design and structure of the bridge of course had nothing to do with the accident. The laced channel members, where subjected to local impact, in practically every case broke with a sharp crystalline fracture, at right angles to the line of member, nearly as perfect a break in line as would have been made with a saw. The lower chords particularly show this kind of break, in each case through rivet lines, and in only one built-up member was it found that

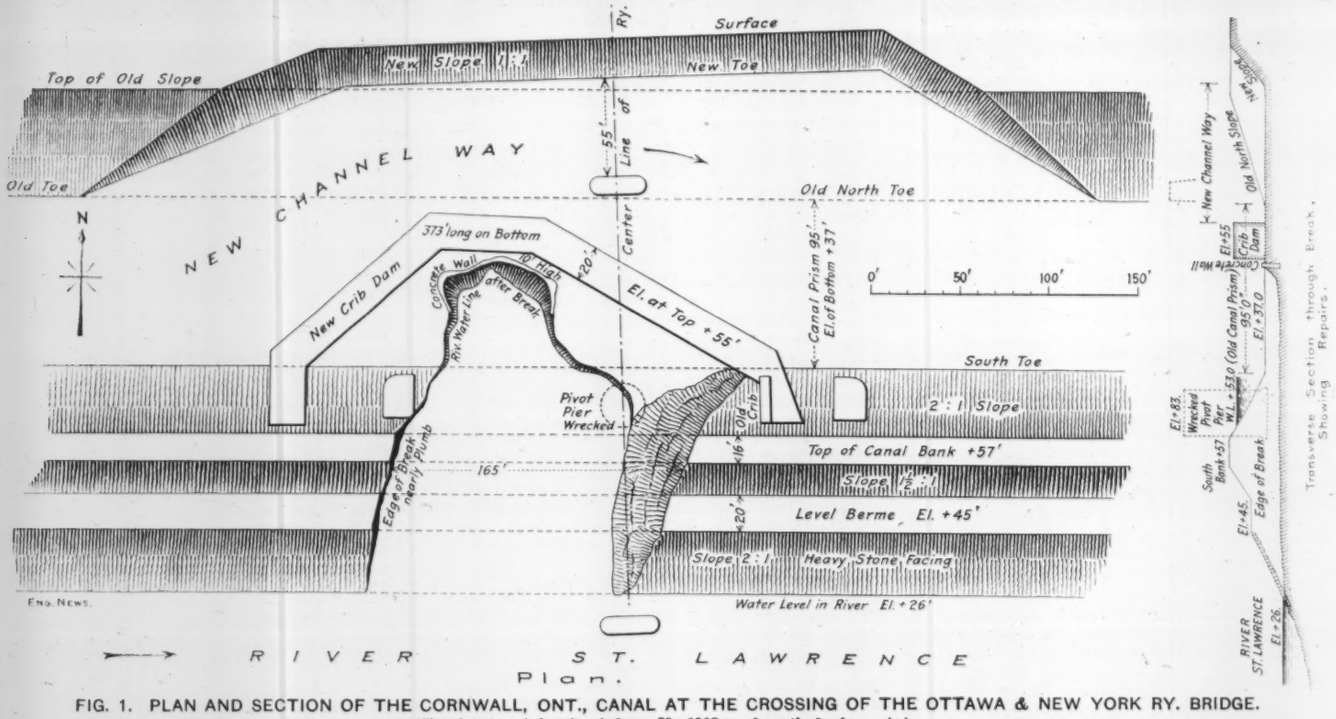


FIG. 1. PLAN AND SECTION OF THE CORNWALL, ONT., CANAL AT THE CROSSING OF THE OTTAWA & NEW YORK RY. BRIDGE.
(Showing canal break of June 23, 1908, and method of repair.)

The cause of the bridge collapse was obviously the undermining of the pier by the waters rushing through the leak in the canal bank. What caused the canal bank to break at just this point is a matter of no exact determination and will probably be laid by most persons to an unfortunate coincidence. However, there are two points to be considered, first that the draw pier was built after the canal bank was a finished structure, and this excavation, with its subsequent filling in around the masonry, may have left a weak place in the bank. Why this should have taken ten years to show itself is not clear. Again, the draw pier was normally open and it is possible that prevailing winds may have acted against its sides and transmitted overturning moments down the pier shaft to loosen the surrounding earth; the unstable supports of the span on its end cribs lending themselves to such an action. But without considering what caused the bank to give way, it must be admitted that the position and nature of the base of the draw pier were not such as successfully to resist the power of the water rushing through the opening weight or impact had caused a bend without breaking. On the contrary, the eye-bar members, subjected to no direct impact, are bent and twisted in a manner similar to the familiar Quebec Bridge eye-bars.

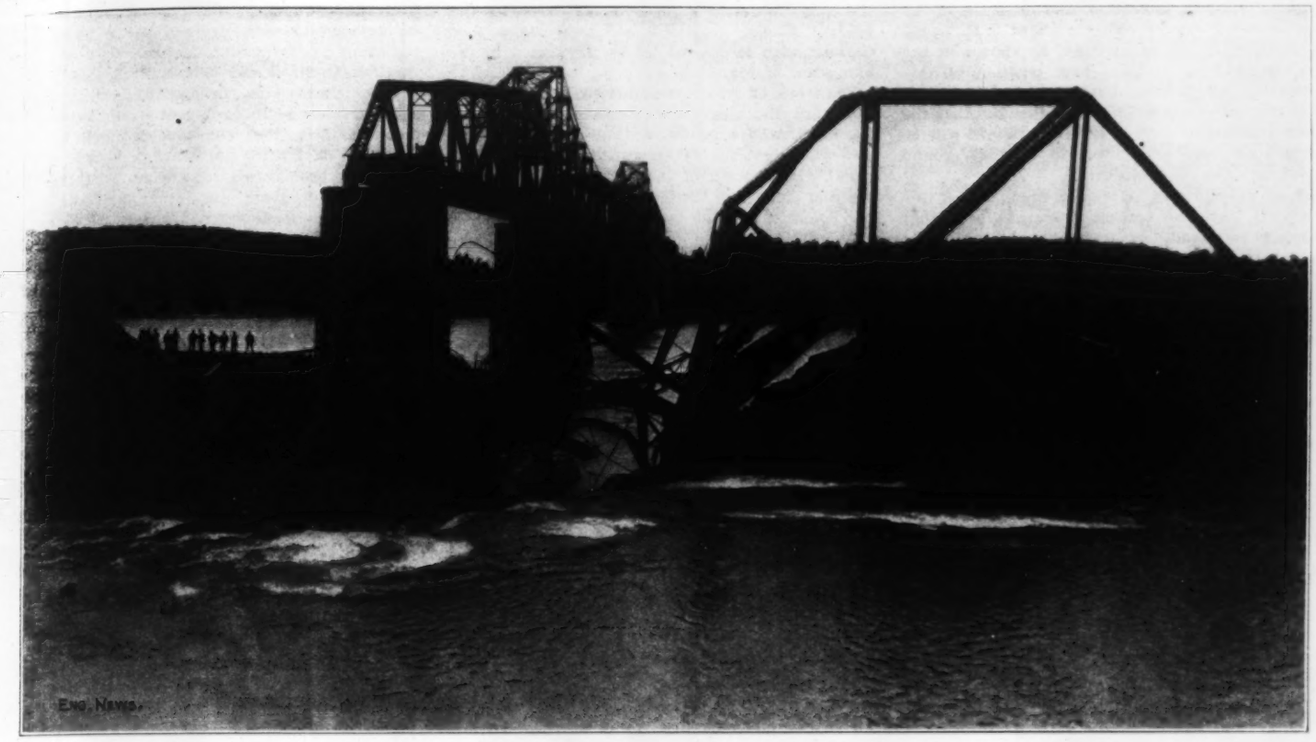


FIG. 2. THE CORNWALL CANAL BREAK, LOOKING SOUTH TOWARD THE RIVER ST. LAWRENCE.
(Taken the day of the break.)

in the canal wall. And behind this footing there are some matters of history in connection with the other piers in this bridge, which make very interesting reading.

The New York & Ottawa Ry. bridge was started in 1897 by the railway company, which was then under separate control from the New York Central Lines, with the Phoenix Bridge Co. contractors for the superstructure and Sooysmith & Co. for the substructure. On Sept. 16, 1898, the entire construction across the American channel then being practically completed, the pier between the two southerly spans collapsed, carrying down these two spans and killing 16 workmen and injuring many others.* It was at first thought that the collapse was due to some fault in the steelwork which caused one of the trusses to fall and to pull down with it the pier and the other truss, but further investigation put the source of trouble on the pier foundation. As is the case in most of the St. Lawrence country, the ground structure below the soil is a good hardpan, underlain and stratified with layers of soft clay and a sand so flowing as almost to be called quicksand. In building the first footings for the Cornwall bridge piers it appears that no thorough investigation of this bottom was made, but that a diver's testimony that the bottom was a good hardpan mixed with large boulders, was taken as sufficient proof of its soundness. The piers were then built, inside of crib cofferdams, of concrete footing a short distance below the river bottom. Below water levels the piers were of mass concrete, above of coursed ashlar backed with concrete. The explanation of the collapse was found to be, in this first collapse, the unstable bottom under the pier. The current of the St. Lawrence, extremely swift at this point, probably washed around the pier footing until it tore out the sand and clay strata and undermined the masonry.

After the accident of 1898, a careful investigation of the ground was made and the treacherous nature of the clay and sand strata discovered. Acting upon this knowledge, the company reconstructed all of the river piers of the bridge. This was done in different ways on the several piers. Some were founded on pile foundations and carefully protected by cribwork and riprap. This scheme was adopted on the pier immediately south of the canal break of June 23 and served, no doubt, to save that pier from overturning under the severe wash of the rushing waters from the canal break. Other piers, which were already constructed at the time of the 1898 accident, were protected by enveloping caissons filled with concrete. So far as can be learned every pier was either reconstructed or protected except the draw pier on the canal bank which was washed away on June 23.

The conditions at this pier were different from those in the river. It was built in the south wall of the canal entirely protected from any current wash of the river, but the ground is of practically the same structure as that found elsewhere on the site. However, the engineers assumed that the hardpan bottom was of sufficient strength and stability to hold the pier

FIG. 3. OVERTURNED PIER AND WRECKED DRAWBRIDGE AT CORNWALL CANAL.
(View taken looking north.)

*Eng. News, V. 40, 1898; pp. 145, 174, 202, 289, 419.

without piling or protection, and constructed the pier with its concrete bottom about 2 ft. below the bottom of the canal bank, as shown in the section on Fig. 1. The exact position of this bottom is not known, but from drawings and testimony at our command it is thought that the given position is correct within 1 ft. It will be noted that this footing was in original ground and not in the canal wall fill.

From examination of the ground where this collapsed pier was placed, it can be seen that the clay and sand formation exist at that point as well as under the rivers. The wash from the break has torn the earth away to an elevation of about the present river level or about 10 ft. below the pier footing, and the exposed faces of the slope are marked plainly with, first, the hardpan on which the pier footed and then the irregular strata of sand and hardpan, which were easily attached by the tearing action of the escaping water.

REPAIR WORK.

In the repairing of a canal in a climate that only permits travel for a portion of the year, the first consideration is rapidity. The cost of the work or its effect on the future permanent repairs can have but little effect on the method of placing the canal in service. In view of some rather unsatisfactory methods pursued in the repair of canal breaks, notably that in the Erie Canal at Syracuse last August,* the work at Cornwall is noteworthy.

Fig. 1 will illustrate the scheme which is now being put into operation. In the first place the tardy shutting off of the water allowed a much greater portion of the canal bottom to be ripped out than if the water could have been promptly stopped. Then the debris from the bridge lies in the canal prism for a greater part of its width. These two conditions made it necessary that the new channel be turned aside from the old. In brief, this is accomplished by building a rock-filled crib dam across the break and around the bridge debris and gully cut by the water, and with this dam as the outside bank of the canal, water is to be let in at the locks and dredges floated in which will excavate a new channel with the inside banks, as shown in the plan view in Fig. 1.

The work of repair was started June 26, using for labor the weavers and other employees of the mills, who were thrown out of work by the power being shut off from the break in the canal. By the aid of the railway officials, timber and stone was started from all the surrounding country, so that by the evening of June 26 the entire job was in good working order. Three shifts of 200 men each covering eight hours make the 24 hour day's work, which was carried on continuously for the first ten days, until the water was let into the new channel and the dredges started. Meanwhile the railway company is preparing plans for reconstruction and aiding the canal engineers in their work of repair.

The new crib is 372 ft. long on the bottom, 20 ft. wide and 19 ft. high and extends, in the curved line shown on the plan, from the west to the east side of the break. It is built of 12 × 12-in. timbers, spaced on 6-ft. centers, both ways, for the bottom four rows and about 8 ft. for the upper layers. The lower timbers, well founded in the leveled canal bottom, are notched and spiked, but the upper ones are only drift-bolted together. The open cribs are filled with boulder stone, mostly taken from the stone fences of the surrounding country. On the inside face of the crib, vertical 3-in. tongue-and-groove plank are spiked, with their scarfed bottoms driven as far down into the canal bottom as is possible by hand driving. On the inside face of these plank a heavy tarred canvas is spiked with its lower edge lapped well over the canal bottom and covered with puddled clay. As a precaution against the crib going out when the water was let into the canal, a gutter was dug on the inside of the crib, about 3 ft. deep and filled with puddled clay, previous to the placing of the canvas, and a concrete wall some 10 ft. high built just outside the crib, across the deepest part of the gully cut by the water. The puddled clay fill is expected to keep the canal water from underwashing and the concrete wall to strengthen the crib against the weakening of the earth due to possible leakage. A small spillway was built across this wall to care for the leakage that comes through the crib. Fig. 5 shows a view of the crib and repair work taken from the first river pier looking north on June 30, seven days after the break occurred.

As has been noted, the work is being done mostly by weavers and other artisans whose previous experience has not been at all along this line of work, but, according to the engineers in charge, their labors have been most efficient, and no little credit should be given to them for their cheerful and well-directed efforts. Luckily, both an electric and a steam railway have tracks very near the work, so that material was easily transported to the site, but with the exception of the derrick working to take down parts of the old viaduct on shore and the power of the railway engines, the only mechanical device on the job is a small hand-winch derrick. Every other bit of work was done by hand. The water was let into the canal on July 4, and the dredges started from either end to excavate the new channel. It is expected that traffic will be resumed about July 12. The railway company has not fully completed its plans for reconstruction, but it is expected that they will strengthen the first shore pier, shown in the view in Figs. 3 and 5, and place thereon a plate-girder draw, taken from some other part of the line, and fill in the remaining portion of the destroyed bridge with a timber trestle, until such time as final repairs can be completed. In the final repair of the canal, it is proposed, though not decided, that a concrete wall be placed along the inside face of the south bank of the canal for a considerable distance on either side of the bridge so that no subsequent break can wash out the bank, together with the pier.

FIG. 4. VIEW OF BREAK SHOWING WALL OF CANAL.
(Paved outer slope showing in background.)

In the absence, through illness, of Mr. M. J. Butler, Deputy Minister and Chief Engineer of the Department of Railway and Canals, Mr. J. L. Weller, Superintending Engineer of the Welland Canal and a former engineer on the Cornwall Canal, is acting in charge of the work of reconstruction. He is seconded in the work by Mr. C. D. Sargent, the present Resident Engineer of the Ontario & St. Lawrence Canals, and Mr. W. A. Stewart, Superintendent of the Ontario & St. Lawrence Canals. We are deeply indebted to these gentlemen for their kindness in putting at our disposal all the information regarding the break and its repair and their courteous treatment of our representative on the site.

*Engineering News: 1907; Aug. 8, p. 151; Aug. 29, p. 219; Sept. 12, p. 276.

PROGRESS IN THE LOETSCHBERG TUNNEL in May again made a high record, beating by a few feet the maximum figure of April, the highest yet reached in that work. The figures are 656 ft. for April and 659 ft. for May, both being for the north heading. The south heading advanced 581 ft. in May, making the total advance of both headings during the month 1,240 ft., about 60 ft. more than in April. The heading work is prosecuted with 3 to 4 percussion drills at each end. About 1,900 men are now employed on the work, 1,120 of whom are at work within the tunnel itself. The north heading tapped large amounts of water during the month, the flow now amounting to nearly 9½ cu. ft. per sec.

TWO YEARS OF THE COOPERATIVE ENGINEERING COURSES AT THE UNIVERSITY OF CINCINNATI.*

By HERMAN SCHNEIDER.†

The cooperative courses as now operated at the University of Cincinnati contemplate that a student shall work alternate weeks in a mechanical, chemical or electrical factory in Cincinnati and at the College of Engineering of the University of Cincinnati. The class is divided into two sections, which alternate with each other during the collegiate year. During the summer, students are employed in the shops full time, but are given a vacation of about three weeks. The course in the shop is carefully planned, and in general the students' work is from the raw material to the finished product sold. They are paid for this shop work on a scale of wages which begins at 10 cts. per hour and increases at the rate of 1 ct. per hour every six months, making the total earnings of the course about $1,800.

The course is six years' long, and is just as thorough, broad and cultural as the four-year course and has the same entrance requirements. Applicants for positions in this work are required to enter the shops about the first of July preceding their entrance to the University and must satisfy the shop owners as to their integrity, zeal, stamina, and adaptability before they will be accepted by the university in the fall. This, briefly, is the cooperative plan.

When the course was begun two years ago, about 30 manufacturers agreed to make the experiment. At the present time there is only one shop of any size in the city of Cincinnati and vicinity which will not gladly accept these student-apprentices.

The first year the course was put into operation about 60 young men came to the university to inquire concerning it. Of these 45 went into the shops, and when the university opened in the fall 28 were left. The second year there were 800 inquiries and applications; from these 60 were selected and sent into the shops, and when the college opened in September 44 were recommended to us and started their university work. This year the applications and inquiries approximate 2,000; from this number we expect to select less than 100 men, and, judging from last year's experience, about two-thirds of these will begin the course in the fall.

It will be evident that the selection from this large number is one of the most serious and important problems which we have to meet, and the work of selection has opened our eyes to some features of engineering education which we believe will be interesting and instructive to the teaching profession.

Seventy-five per cent. of the applications are from young men who desire to become electrical engineers. As far as possible every prospective student is personally interviewed, and upon his statement that he desires to become an electrical engineer, he is immediately asked, "Why?" The answers usually indicate that the student has one of two ideas: First, he has read that this is the electrical age and that a man in order to acquire money in the future must be an electrical engineer. His impression is that an electrical engineer is one who does spectacular things. He has what we have come to call the "dazzle idea," to use a phrase of the day. His conception seems to be that electrical engineering is a series of bizarre "stunts." Of the hard and tedious problems which confront the electrical engineer, he has absolutely no idea. The second class are those who think that electrical engineering is wiring a house. It is astonishing how many high school graduates have this conception.

In the interviews the real object of the electrical engineer's career is pointed out to the young man and he is told what the six year's cooperative course means in hard and laborious shop work. Many of the applicants, of course, withdraw when they learn that electrical engineering is not a pyrotechnic display, or when they are told that they can learn how to wire a house in six weeks at a night school. A considerable number also surrender to mental cowardice in the matter of dirty work, long hours and shop discipline. If we can get one good man, sound mentally, sound physically and temperamentally adapted to the profession, out of 25 applicants, we consider that we are doing fairly well.

Yet this is the material which enters our engineering schools, with the same distorted ideas; and so far as the writer knows, our colleges do not tell them what electrical engineering really means. I venture the assertion that if a thorough canvass were made of freshmen electrical engineers, the majority of them would be found to have the "dazzle idea."

In mechanical engineering applicants seem to have a better grasp of what the words mean, and we get one good man in about ten. In chemical engineering the same fairly good knowledge of the intent of the course is shown.

In selecting a student the question in the mind of the writer has always been: "Is this young man before me the kind of a man on whom the university should spend about $1,600?" This brings up, as you will see, the whole problem of the economics of engineering education. The scope of this paper will not permit as thorough a discussion of this subject as it should have, but the essential ideas will be outlined.

It costs any self-respecting institution about $2,000 for every student it graduates. The student pays to the school from $200 to $1,000 for his instruction. The school therefore expends on the student anywhere from $1,000 to $1,800. This money is obtained either from endowments or from taxes. In either case it is a public trust, held by the trustees of the school, to be used by the faculty for the benefit of the public through the education of young men. If we are going to spend from $1,000 to $1,800 on every graduate, is it not a reasonable business proposition to select the men on whom the money is to be expended?

The criterion which we have adopted may be stated as follows: Only that man should receive a higher education who would in all probability be successful without it, and this is really the basis of our selection as far as human judgment and careful observation can make it. There is nothing more helpless and hopeless than the educated "mollycoddle"; and there is nothing in all our educational system so wasteful as the present scheme whereby any young man who has the money and enough brains merely to get through certain mental work is given training, which is denied to a young man of much superior general ability, but with a lack of funds. Parenthetically it may be stated here that a large proportion of the failures in the course have been city-bred boys; country boys as a rule "make good." As a matter of fact, some of our largest concerns will not accept city-bred boys in the future.

There is a large measure of economy in the cooperative course by reason of the fact that the university is not required to equip, maintain, and supervise practice shops. The manufacturing shops of Cincinnati are the practice shops of the university, and the student, instead of paying us for instruction, receives much superior training in the factories and is paid for his work. Engineering laboratories can be cut down in equipment to a certain extent without any loss in efficiency, for the testing-rooms and engine-rooms of the commercial shops become in a measure our engineering laboratories.

The cooperative course has students who are in dead earnest. Further, they have practical experience. As a result they get much more out of the same amount of theory than the four-year students do. In other words, the efficiency of the instruction per hour is increased.

FIG. 5. VIEW OF REPAIRS ON CORNWALL CANAL.
(Looking north on June 30, seven days after break.)

*A paper read before the Society for the Promotion of Engineering Education, at Detroit, Mich., June 27, 1908. See also paper by Prof. Schneider in Engineering News of July 18, 1907.

†Dean, College of Engineering, University of Cincinnati, Cincinnati, Ohio.

In the cooperative course the weaker brother is eliminated before he enters college. In the four-year course he is eliminated during the first, second and third years. In the former case the raw material is carefully selected. In the latter, little attention is given to the raw material except as defects show in the making of the product—that is, after expensive work has been done on it.

It is hard to make an accurate determination of the relative efficiency of instruction in the four-year and the cooperative courses. The records in one or two subjects, however, will indicate about what this would be. In calculus, for instance, not one of the cooperative students failed. The lowest grade received by any cooperative student was 73 (60 being the passing grade and 100 the maximum), and fifty per cent. of the class received over 90. In the regular four-year engineering course, on the contrary, about twenty per cent. of our students failed in calculus and few received a grade above 90. In this connection the fact should be noted that the examination given to cooperative students was harder than that given to regular students. In chemistry the cooperative students and the regular students have the same examination, answering exactly the same questions. Ninety per cent. of the cooperative students passed and about eighty per cent. of the regular students. This need not be astonishing, for, with few exceptions, the cooperative course is not carrying any dead wood. It will be seen, therefore, that since the efficiency of the instructor depends primarily upon the amount of actual substance absorbed by the class, it is increased very considerably in the cooperative courses.

When this system was started two years ago many questions of detail arose. For instance, the matter of the rearrangement of the college courses was taken up. It was concluded, however, that the best thing for us to do would be to learn by experience. We are happily being driven from traditional methods by the cooperative students themselves. Here is a sample of what happens:

The instructor in mathematics covers the blackboard with the demonstration of a long formula, and when he has finished it he turns to the class and asks, "Do you understand that?" The class replies that it does, but inquires seriously, "What shall we do with it?" This has happened a number of times, and at first caused much annoyance to the instructor; but when it was pointed out to him that if a thing had no use it was useless and should not be taught in an engineering college, light dawned on him, and he now spends much of his time hunting practical exemplifications of theory.

This is the characteristic attitude of the cooperative student, and it is not surprising. Our four-year students are accustomed to being handed a formula which they hold until examination time, when they hand it back. The cooperative student in the shop is handed a tool and is instructed how to use it. He uses it, hands it back to the tool-room, and thereafter knows where to find the tool and how to use it. When he is handed a formula or a theory at the university it is a matter of second nature to him to expect to be shown how to use that formula or theory prior to his handing it back. Thereafter, as with the tool, he knows where to find it and how to use it.

We have inaugurated what we call the "reverse quiz" in class. Toward the end of the hour students are given permission to ask any questions that have a bearing upon the subject, and this has been perhaps the most valuable addition to our system. It is, of course, uncomfortable for a young instructor, but if he is the kind of a teacher our engineering college ought to have, he will work to meet the situation. The shop knowledge of the student has demonstrated to us the fact that some of the instruction in our colleges is not only frequently out of date, but also that it is as often absolutely wrong. You will observe that there is a check upon the instructor's work which cannot be had in any other way except through this practical knowledge of the student.

The questions of these young men have caused us to change our courses and will cause many more changes as the work advances. Mathematics, for instance, is taught as one subject, the fundamental principles of university algebra, trigonometry, analytical geometry, and calculus being given during the first part of the freshman year; and thereafter any one formula is derived by the different methods. The course in mechanics is taught as part of the course in calculus. Descriptive geometry and machine drawing will hereafter be given as one subject, because when a student was given a problem in descriptive geometry he wanted to know its application, and when told the application, wanted to know whether he could not put it at once on the same sheet.

It will be seen, therefore, that while we simply took the four-year course at the beginning and spread it over a period of six years, we are changing it considerably, by reason of the experiences which we have in every day class work.

It has become evident also that it will be necessary to bring some of the engineering work down into the earlier years. As a counterbalance to the essentially practical attitude of the student we have inaugurated a broadening course in the social, economic, industrial and political development of the human race, together with courses in biology and geology. It was originally intended that this course should cover a period of three years, but we are now inclined to give it through the entire six years.

The alternating periods were fixed at one week tentatively, and this has proven very satisfactory. A vote of the students was recently taken, and they were unanimously in favor of the one-week period as giving them the proper alternation of mental and physical work. They also state that absence from the shop for more than a week allows their muscles to become soft, and for this reason they prefer to continue on the week system. The shop also desires to keep this period of one week, because if the period were made longer at the university the student would lose some of his skill by the time he returned to the shop. It has been definitely concluded, however, that when the young men go into the designing and sales offices—which will be about the fifth year—the alteration will be by semesters. It will be impossible for a young man to work in a designing or sales office with any benefit to himself or to the firm for a shorter period than six months. The students in the cooperative course will then enter the regular classes at the university, when a better comparison of the work of the two classes of men can be made.

Since the cooperative student is at the university for a period of three years, as compared with four years of the regular student, it became evident, of course, that he would be required to do more actual class and laboratory work per week than our regular students. Additional hours were given to him during his alternate week at the university, and the roster was considered by some of our faculty to be too heavy. At the end of the first year, however, the students finished without any seeming effort and with much better records than did our regular students. This year a further experiment was tried by the writer on the freshman cooperative class by giving them work every period of the day from 8.30 until 5 o'clock, with one-half hour for lunch, except on Saturday morning, when they work from 8.30 until 10.30 o'clock. This, it will be seen, is about the heaviest roster the student can possibly carry. At the end of the year the men were more vigorous, mentally and physically, than they were in September. They were more active in university social affairs, athletics, and general student life than the regular students, and they had made much better scholastic records. This seems to be a demonstration of the statement that "if you want a thing done, ask the busy man to do it."

The fundamental principle underlying this course is based upon the rational assumption that the proper way and the only way for a young man to learn the practical side of his profession, together with business details and an intimate knowledge of the labor problem, is by working as a regular employee in a commercial shop; and further, that the only place where he can learn properly the scientific and the cultural subjects is at a school under trained teachers. This further implies that the school work and the practical work should, as far as possible, go hand in hand, so that the young man may step from school to business just as readily as he does from one promotion to another in after life. The writer believes this principle to be all-important and to apply to all engineering and industrial education.

At the University of Cincinnati there is no cooperative course in civil engineering, because the local conditions will not permit. There could be one, for instance, at Pittsburg, in connection with the American Bridge Company and the railroad lines centering in that city. The Pittsburg school could have also cooperative courses in mechanical, electrical and metallurgical engineering. At Philadelphia there could be courses in marine engineering and naval architecture as well as in mechanical engineering. The plan contemplates that the school shall have cooperative courses in all those departments which have a sufficient number of industries to make the operation of the course possible. The details will be matters of compromise, as they are with us at the present time. An eastern engineering school about to install this system with a large manufacturing plant in its vicinity contemplates having a two or three-week alternation system, with gradually increasing periods to graduation, the last year of the course to be spent in school. As stated above, this is all detail and simply a matter of local conditions and compromise.

In conclusion, permit me to call your attention to the fact that educational methods are traditional. Oxford and Cambridge were an outgrowth of the old monastic system of withdrawing young men from the world for religious contemplation and literary pursuits. Yale, Harvard and Princeton were patterned after Oxford and Cambridge, and every engineering college is an offshoot of a school founded upon this old academic idea; consequently we have the absurd system to-day which withdraws young men from all contact with the world's work to prepare them for that work.

Every scholastically trained man at first objects to this cooperative system, for the simple reason that it is not the way in which he was trained. It is astonishing how hard it has been to overcome this bias of tradition. College graduates have a peculiar reverence for the customs and forms of their college days, simply because they were in the college environment at the impressionable age; consequently any plan which tends to change radically the way things were done when they were in college meets with opposition which is based on sentiment rather than on logic.

But putting aside for the time being the question of the ultimate destiny of the cooperative system of education, I want to ask and have you answer for yourselves frankly this question:

If the men who occupy the engineering chairs in, say, the three best engineering institutions of this country were to meet with the chief engineers and the general superintendents of the three largest electrical companies of the United States to plan for the instruction of young men in the professions of electrical and mechanical engineering, and if they did not permit themselves to be hampered by the precedents of the old academic system and biased by the methods of their own scholastic preparations, do you suppose they would devise the present four-year system?

Would they not, with their knowledge of the requirements which an engineer should fulfill, plan a course which does not teach almost solely from books? Would they not give a young man in his formative years that broader education of life which breeds determination from the doing of disagreeable tasks; which builds a physical constitution to help stand the mental stress of the future; which molds a spirit of broad toleration by daily contact with the inflexible limitations of man as the Creator has made him; which stirs initiative to accomplishment by ability to do as well as to think; and which bases the value of money upon work efficiently done, rather than upon the pleasure it can buy?

Would they so plan that the engineer would have the narrow one-sided view-point obtained wholly from books, rather than the clear judgment derived from experience properly supplemented by instruction? Would they devise a course almost entirely given to analytical investigation, or would they incorporate a goodly portion of constructive action? Would they not plan a foundation more in accordance with the specifications which that great philosopher Huxley stated in his definition of a liberal education?

"That man, I think," said Huxley, "has had a liberal education whose body has been so trained in youth that it is the ready servant of his will, and does with ease and pleasure all that, as a mechanism, it is capable of; whose intellect is a clear, cold logic engine, with all its parts of equal strength and in smooth running order, ready, like a steam engine, to be turned to any kind of work and to spin the gossamers as well as forge the anchors of the mind; whose mind is stored with the knowledge of the great fundamental truths of nature and of the laws of her operations; one who, no stunted ascetic, is full of life and fire, but whose passions have been trained to come to heel by a vigorous will, the servant of a tender conscience; one who has learned to love all beauty, whether of nature or of art, to hate all vileness and to esteem others as himself."

THE RANK OF TECHNICAL GRADUATES IN THE ENGINEERING PROFESSION—A STUDY OF STATISTICS OF UNIVERSITY OF MICHIGAN GRADUATES.

Mr. W. W. Brigden, President of the Michigan Engineering Society, is reported to have said at a meeting of that society, held Jan. 7 at Battle Creek, that university presidents and professors greatly overrated the value of a technical education, and that

not more than half the graduates of engineering schools ever put their education to any considerable use. . . . Modern technical graduates who achieve fame could almost be counted on one's fingers.

As a reply to this, Prof. John R. Allen, M. Am. Soc. M. E., prepared the following table concerning the graduates in mechanical engineering, from the University of Michigan, 1883 to 1897:

Position.	Number of men.	Percentage.
Presidents of Manufacturing Corporations	9	10.6
Vice-Presidents or Secretaries	4	4.7
General Managers	12	14.0
Superintendents	4	4.7
Chief Engineers	22	26.0
Consulting Engineers	11	13.0
Patent Attorneys	3	3.5
Professors	3	3.5
Chief Draftsmen, etc.	12	14.0
In other professions	5	6.0
Total	85	100.0

STREET-RAILWAY MAIL CARS have been introduced by the Imperial German Post-Office in the city of Strassburg, after they had already been put into use in Frankfurt a. M. They have a small compartment for letter and registered mail, a larger one for parcels mail, and a third compartment for postal employees. These cars make 20 to 35 trips per day between the main post-office and the railway post-office.

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The railway statistics in "Poor's Manual" for 1908, just issued, furnish material from which an interesting comparison may be made showing the changes in the American railway system in a quarter century.

In 1882 there were 114,677 miles of railway in operation, and in 1907 there were 228,128 miles, or almost exactly double. Traffic has increased, however, much more rapidly than mileage. The 15,000 locomotives in service in 1882 are contrasted with 58,300 in 1907; and the new locomotives probably average fully double the traffic capacity of the old. The 15,000 passenger cars of 1882 have become 35,300 in 1907. The increase was less rapid than in the case of the locomotives. This is due to the large relative growth of freight traffic and the diversion of a considerable proportion of the passenger traffic to electric railways. The 730,000 freight cars of 1882 became 2,084,000 in 1907; and here again, capacity per car was certainly doubled. The total miles of track, including second, third and fourth track and sidings, grew from 141,000 miles in 1882 to 324,000 miles in 1907. It is of interest to note also that in 1882 over half the railway mileage was still laid with iron rails, the total being 74,267 miles, compared with 67,000 miles of steel rails. In 1907 there are only 9,320 miles of iron rails left, which one would suppose must by this time resemble the traditional "two streaks of rust."

Turning to figures of capitalization and earnings, we find that in 1882 the average rate of interest on bonds was 4.94%. In 1907 this has fallen to 3.87%. The bonded debt per mile, however, rose from $28,000 per mile in 1882 to $36,690 per mile in 1907. The stock issued also rose, from $30,400 in 1882 to $33,200 in 1907. In the intervening years, however, the stock issue fell to as low as $27,800 per mile in 1889. The dividends paid on stock rose from an average of only 2.76% in 1882 to 3.73% in 1907, by far the highest on record. In the intervening years, however, the dividend rate fell as low as 1.51% in 1897. The average receipts per ton-mile of freight carried, which was 1.224 cts. in 1882 dropped to 0.782 ct. in 1907, and in 1901 was as low as 0.756 ct. Passenger earnings per passenger-mile, which were 2.42 cts. in 1882 were 2.04 cts. in 1907, and fell in 1898 to 1.994 cts. The gross earnings per mile of road which were $7,405 in 1882 rose to $11,556 in 1907, and the net earnings in the same time grew from $2,679 to $3,700. During the quarter century, however, gross earnings fell to $6,054 per mile in 1894, and net earnings in both 1894 and 1895 were only $1,803 per mile.

Leading engineers have urged for some time that guarantees of maintenance on asphalt paving should be eliminated, or at least reduced in length. A court decision bearing on this has recently been rendered by the Appellate Division of the New York Supreme Court. The decision makes invalid the maintenance clause in a contract for paving in Jamestown, N. Y.

The court held that where a city charter required the cost of the original pavement only to be paid by the abutting property owners, and the city to bear the expense of repairs and maintenance, a contract which requires the contractor to make for ten years repairs necessitated not only by defective materials and workmanship, but also by wear and tear and the action of the elements, placed the burden of maintenance on the property owners, and was, therefore, void, in the absence of evidence that with proper construction and material the original pavement would last for the period covered by the guarantee.

In this connection the annual report of the General Asphalt Co. contains some interesting statements respecting the guarantee clause in contracts. We quote as follows:

From 1890 to 1900 guarantees were given under an inadequate conception of the risks involved in the continuing obligation thereby imposed over a long term of years. These guarantees were accepted for the purpose of securing an immediate profit in the construction of the pavement, and without sufficient experience or data to form a reasonable estimate of the cost involved in the guarantee. These long-term guarantees are now gradually expiring, the last 15-year guarantee having been taken in 1901. The company now confines its contracting operations to pavements of shorter guarantee and favorable traffic conditions.

Cities have found out from experience that if a pavement is improperly constructed, a long guarantee, even if accompanied by bond, is an unsatisfactory means of assuring its proper repair. Obviously, the best assurance that a city can have is a pavement properly constructed at the outset, and this view is now resulting in a gradual shortening of the term of guarantee, with reduction in cost of the pavement, and, in many cities, of waiving entirely the requirements for any guarantee.

The following table shows the average length of guarantee of the asphalt pavements laid by this company during the past five years, and the percentage of yardage on which there was no guarantee.

	Average length of guarantee.	Percentage with no guarantee.
1903.....	7.5 years	4 per cent.
1904.....	7.3 "	6 "
1905.....	7.5 "	5 "
1906.....	7.3 "	9 "
1907.....	5.4 "	26 "

As those of our readers who follow the newspapers and popular magazines are aware, the city of San Francisco has been the scene during the past year of a most remarkable battle for honesty in municipal government and for the due punishment of those who have for years made that city a stench in the nostrils of decent men. The leaders in this campaign for honesty in carrying on the city's business have been Rudolph Spreckels, a man of great wealth and large public spirit, and Francis J. Heney, who has made a reputation on the Pacific Coast for his fearless work as a prosecutor of strongly intrenched criminals.

As often happens, the earnest and patriotic men who have been risking their lives and fortunes in endeavoring to establish decent government in San Francisco, have had to contend, not alone with the forces of evil which openly and shamelessly acknowledge their character, but with the opposition of many wealthy and influential men in the community who for one reason or another are tied up to the evil order of things that has prevailed in the past.

Under these circumstances President Roosevelt on June 8 last addressed a letter to Mr. Spreckels which it has seemed to us well worth while to print in this place at this time.

In this year of grace, 1908, when our National holiday ought to turn the minds of thoughtful men toward patriotic subjects, is it not well to reflect on what sort of patriotism is most needed to-day in order that "Government of the people, by the people and for the people shall not perish from the earth"?

The issues of 1776 or of 1860 are not the issues of to-day. The real foes to freedom—freedom for each man to enjoy life, liberty and the pursuit of happiness—are those who would debase our governments, and make them an instrument for exploiting the many for the benefit of the few. And the most guilty are they who with large opportunity and with all the advantages of education, intelligence and wealth, choose to ally themselves with the forces of evil rather than the forces which make for good.

Not without significance is it that a grandson of a great statesman and Vice-President of the United States is found at San Francisco as President of a street railway company which obtained franchises from public officials by methods which will not bear the light of day.

That great man, twice President of the United States, in whose memory the flags are now floating at half mast, will be remembered for the phrase "public office is a public trust."

But the public, in its turn, owes its support to the public officer who is faithful to his trust—who is faithful—let us emphasize, to the interests of the whole people and not to the interests of a privileged few. And if such support is the duty of the ordinary citizen, how much more is it the duty of the intelligent and educated and cultured? The interests which represent property and wealth have the greatest stake in the perpetuation of good government. Even though at the moment it may suit some special class or interests to have a public official who can be bought or who will favor capital rather than labor when class interests clash, yet in the long run the safety and security of property depend absolutely on the preservation of honest government. Those, therefore, who unthinkingly condemn a public official because he steadfastly stands for the public interest are traitors to their own best interest as well as traitors to their country's welfare.

President Roosevelt's letter follows:

The White House, Washington, June 8, 1908.

My dear Mr. Spreckels:

Now and then you and Mr. Heney and the others who are associated with you must feel down-hearted when you see men guilty of atrocious crimes who for some cause or other succeed in escaping punishment, and especially when you see men of wealth, of high business, and, in a sense, of high social standing, banded together against you.

My dear sir, I want you to feel that your experience is simply the experience of all of us who are engaged in this fight. There is no form of slander and wicked falsehood which will not as a matter of course be employed against all men engaged in such a struggle, and this not only on the part of men and papers representing the lowest type of demagogy, but, I am sorry to say, also on the part of men and papers representing the interests that call themselves pre-eminently conservative, pre-eminently cultured.

In such a struggle it is too often true that the feeling against those engaged in it becomes peculiarly bitter, not merely in the business houses of the great financiers who directly profit by the wrongdoing, but also in the clubs, in certain newspaper offices where business interests exercise an unhealthy control and, I regret to add, in other newspaper offices which like to be considered as in a marked degree the representatives of the cultivation and high social standing of the country.

Now, I do hope that you and your colleagues will treat all this bitterness with entire disregard. It is of small consequence to you, or to any of us who are engaged in this work, whether men think well or ill of us personally; but it is of very great consequence that we should do the work without flinching, on the one hand, and, on the other hand, without losing our good humored common sense, without becoming angered and irritated to a degree that will in any way cause us to lose our heads.

Therefore, I hope that you and Heney and your associates will keep reasonably good natured; but that above all things you will not lose heart. You must battle on valiantly, no matter what the biggest business men may say, no matter what the mob may say, no matter what may be said by that element which may be regarded as socially the highest element. You must steadfastly oppose those foolish or wicked men who would substitute

class consciousness and loyalty to class interests, for loyalty to American citizenship as a whole, for loyalty to the immutable laws of righteousness, of just and fair dealing as between man and man.

It is just as bad to be ruled by a plutocracy as by a mob. It is profoundly un-American and, in a social sense, profoundly immoral, to stand for or against a given man, not because he is or is not a brave, upright, and able man, but because he does or does not belong to a labor union or does or does not represent the big business interests. In their essence, down at the foundation of things, the ties that are all-important are those that knit honest men, brave men, square dealing men, together, and it is a mighty poor substitute if we replace these ties by those that bind men together, whether they are good or bad, simply because they follow a particular business, have a given social standing, or belong to a particular organization. It is an evil and a dreadful thing for laboring men to endeavor to secure the political dominance of labor unions by conniving at crookedness or violence, by being "loyal" to crooked labor leaders, for to be "loyal" to the fancied interests of the union when they are against the laws of morality and the interests of the whole people means ultimately the destruction of the unions themselves, as an incident to the destruction of all good citizenship.

But it is, if anything, an even more evil and dreadful thing to have the merchants, the business men, the captains of industry accessories to crime and shielders and supporters of criminals; it is an even more dreadful thing to see the power of men high in State politics, high in finance, high in the social life of the rich and fashionable, united to stifle the prosecution of offenders against civic integrity if these offenders happen to be their friends and associates; and most evil of all is it when we see crooks of a labor party in offensive and defensive alliance with the crooks of a corporation party. Labor unions and corporations alike should be heartily supported when they do good work, and fearlessly opposed when they stand for what is evil. The best kind of wage-worker, the best kind of laboring-man, must stand shoulder to shoulder with the best kind of professional man, with the best kind of business-man, in putting a stop to the undermining of civic decency, and this without any regard to whether it is a labor union or a corporation which is undermining it, without any regard to whether the offender is a rich man or a poor man.

Indeed, if there can be any degree in the contemptuous abhorrence with which right-thinking citizens should regard corruption, it must be felt in its most extreme form for the so-called "best citizens," the men high in business and social life, who, by backing up or by preventing the punishment of wealthy criminals, set the seal of their approval on crime and give honor to rich felons. The most powerful ally of lawlessness and mob violence is the man, whoever he may be, politician or business-man, judge or lawyer, capitalist or editor, who in any way or shape works so as to shield wealthy and powerful wrong-doers from the consequences of their misconduct.

You have heart-breaking difficulties with which to contend. You have to fight not only the banded powers of evil, but, alas, that it should be said, the supineness and indifference of many good men on whose zealous support you had a right to feel that you could rely. Do not be discouraged; do not flinch. You are in a fight for plain decency, for the plain democracy of the plain people, who believe in honesty and in fair dealing as between man and man. Do not become disheartened. Keep up the fight.

Very sincerely yours,
Theodore Roosevelt.

At the recent convention of the American Institute of Electrical Engineers notable and unmistakable evidence of the true patriotism of engineers, though not of the loud-voiced, flag-waving variety, was manifest. Possibly the particular trend of its manifestation is a result of the recently inaugurated agitation for the conservation of the natural resources of the country. At any rate the views expressed by many individual members of the American Institute of Electrical Engineers in regard to the proper government policy for the development of water power on forest reserves, must be especially gratifying to those who are seeking to advance the interests of the greatest number of the people in these future developments. It must have been gratifying also to those who maintain that the engineer, by education, by experience and by a developed power and sense of logical deduction is entitled to a more prominent position in the councils of the nation. A well-known engineer, long connected with a concern developing and operating a hydro-electric power system, perhaps the largest in the world, presented a paper in which he suggested, as a government policy in regard to water power development in forest reserve lands, that any such a development was a purely local thing; that it should in all ways be considered with regard to the local area immediately served; that all revenue to the government from such a development should be expended for the local conservation only.

The individual engineers, in discussing this paper, put themselves on record in unmistakable terms against such a view. Private interests were to be that much disregarded. The keynote of the discussion was "the greatest good for the greatest number for the longest time." That forest areas and water falls were mere local property was emphatically denied. It was unanimously agreed that the development of a Pacific-slope power was of vital consequence to New England, and that the development of all possible power in the Appalachians worked a benefit to people in the Far West.

These men largely trained to the service of private interests held to the principle that it was for the good of the country that the revenue from all profitable developments on government conserved areas should contribute, without respect to geographical distribution, to the upbuilding of mutilated or wasted power sites.

NEW THINGS IN ENGINEERING EDUCATION.

There is one subject in engineering on which there is none so poor as to be without an opinion. At your engineering society meetings discussion on all other subjects may fall flat; but when engineering education is broached the tidegates of talk are opened wide.

It is not strange that this should be the case. Most engineers know a good deal of a few branches of engineering and confess ignorance as to all the rest. All engineers, however, have had an education—if only in the school of hard knocks—and most of them have opinions as to how the course of instruction could be bettered. Hence when opinions are called for there is always an ample supply.

There is one class of engineers, however, whose opinions on engineering education are particularly entitled to respect. That is the engineers who are engaged in the actual work of professional instruction. As our readers know, there is a society—now 15 years old—composed of men who are engaged—let us not say in the manufacture of engineers, but in the molding of blanks which are to be stamped later by the dies of human experience. This society—the Society for the Promotion of Engineering Education, to give it its official title—held its annual convention last month at Detroit. The papers and discussions there indicate the changes which are taking place and show that the teaching staff in our engineering schools are fully alive to the criticisms that are being made. In fact they are in some cases quite possibly inclined to give too much weight to the opinions of the so-called practical men. The tendency toward specialization in education for example—establishing courses in this or that or the other special branch of engineering—is due rather to parents and trustees and employers than to the sound judgment of our best educators. So, too, part of the crowding of the courses and overloading the student with work on a multiplicity of topics is probably due to ill-considered criticisms of graduates and others. It is easy when one finds an engineering graduate ignorant of cost keeping, or lettering or transit work or technical German, to say that these things ought to be taught in the schools. But no such offhand judgment ought to be made. Perhaps these subjects—excellent as they are—would overload a course already full to the limit. Perhaps skill in lettering would be gained at the sacrifice of time which needs to be devoted to physics or chemistry.

The main point we would emphasize, however, is the fact that the engineers engaged in the work of teaching are not—as is sometimes claimed—clinging to past traditions and standing in the way of progress. On the contrary, they are adopting and altering the courses of study to meet public criticism quite as rapidly and radically, probably, as the conditions warrant.

Of course the need of change in these courses is generally admitted. It is no argument against such changes to say that the courses of study in vogue 25 or 40 years ago produced men who have achieved national distinction. The same thing is true of the barren old courses in the dead languages, of which a college education a century ago was chiefly made up. The same argument has been used also against all education by the schools.

We must remember that the young graduates who were turned out of Rensselaer or the Thayer school back in the '60's or '70's, with a foundation of mathematics and little else knocked at the doors of a very different profession from the engineering profession of to-day. Changes demanded in the courses of study in our engineering schools to keep pace with the changes in the profession itself.

How great those changes have been, even those comparatively young in the profession can see. There is room and need to-day for many kinds of engineering education. The industries call for designers, draftsmen, inspectors, foremen, superintendents, managers, and there is ever increasing opportunity for those who take up purely professional work.

Viewed from this standpoint, the merit of such a departure as that inaugurated at the University of Cincinnati, described in this issue, can be readily seen. Its graduates will be undoubtedly specially fitted to undertake the work of factory management—manufacturing engineering, as it has been termed. On the other hand, the boy who does all the college work which they do and who devotes the three years which they spend mastering shop processes to the study—practical study we mean—of a variety of branches of engineering work, will be fitted for work entirely different.

A particularly commendable feature of the University of Cincinnati's plan is that it opens a door to the youth who has the ability and the ambition to become an engineer, but who has to earn his own living.

And this leads us to say that one of the changes of the past quarter century in our engineering schools has had an unfortunate effect. We refer to the raising of the requirements for entrance. The tendency has been to shut out from the engineering courses youths who may have all the qualifications to make first-class engineers and yet who are deficient in mathematical ability, or ability to master other scholastic branches. It is true that some educators have in the past confused engineering and mathematics. It is true, too, that there has been a tendency—partly the result it may be of this school training—to reduce engineering problems to a mathematical basis and make the application of a formula take the place of sound and educated and trained judgment.

There is, however, we believe, less of this misapplication of mathematics now than there was in the early days of engineering education. There is, too, a formal admission on the part of leading engineering educators that the modern languages—French and German and Spanish—are not the essentials to our engineering education that they were considered a dozen years or more ago.

The question comes, therefore, whether the increased requirements for entrance do not tend to shut out from the regular engineering courses a really desirable class of youths—whether the basing of the requirements for entrance on scholarship alone does not tend to evolve a generation of scholastic engineers. Every engineer of long experience can recall men who were eminent in the practical ability to do things, who had the ability to make good engineers and yet were poor students in school. All will agree on the desirability that the engineers of the future should be men fitted by natural ability for their life work; but the complaint heard at Atlantic City last week, in the discussion of engineering education by the American Institute of Electrical Engineers, was that many of the graduates now turned out by the colleges have

nothing but the college training and no natural fitness for the work of the profession to back it up.

But before we blame the engineering educators for raising the entrance requirements we must recall the situation that has confronted them. These dozen years, students have been knocking at their doors in greater numbers than could be accommodated. Some sort of sifting process must take place. These dozen and more years, too, the practical men have been appealing to have this and that and the other "practical" branch added to the course of instruction. What was more natural, therefore, than that some of the foundation work in mathematics, in the modern languages and in science should be passed back to the secondary schools by increasing the entrance requirements.

Can the engineering colleges do anything else than this? Could they set up any other tests of a boy's fitness for the engineering profession than his scholastic attainments? We ask these questions, but we shall not now attempt to answer them.

In one of the discussions at the recent Detroit meeting, one speaker remarked that it was a pity that there was not yet such a thing as standard entrance requirements to the engineering colleges and a standard course of study.

In our opinion, however, it would be far from desirable to reduce all our engineering schools to one cut and dried order. There is room in the profession for a great variety of engineers with very diverse training and preparation. Further, the boys who are coming forward for preparation to fill the places of those now in active life differ as widely. We welcome such departures as that at the University of Cincinnati; but we should regret to see all our engineering courses altered to the cooperative plan, excellent as are many of its features. We rejoice at the growth of the great correspondence schools and at the knowledge that many young men are being aided by them to fill useful places in the army of engineering workers—an army—let us add in which any private is eligible for the highest rank, no matter what his schooling may have been. On the other hand we have no objection to raise to the schools which propose to require an A. B. degree as a requisite to entrance. They will draw few students from the young men who have their own way to make in the world; but the boys so fortunate—or unfortunate—as to inherit large property can afford to take two or three extra years for the culture studies; and if the culture studies "take," they should be so much the better, as engineers and as men.

There are two opposing tendencies at work in our engineering schools. On the one hand we have the tendency toward teaching the practical details of engineering work, giving the student familiarity enough and skill enough with the methods and tools so that he can go out and earn a fair salary immediately on graduation. For example, 25 years ago most civil engineering schools—and there was little else at that time—aimed to fit their students to take a transitman's position on railway location immediately on graduation.

On the other hand there is the movement to eliminate all the detail work, all the time spent in acquiring mere skill in performing certain operations with instruments or tools. The time thus saved could be devoted to more thorough grounding in the foundation studies, to instruction in a wider range of engineering branches and to a liberal amount of culture studies. This latter plan, well seasoned with such practical applications as will make the instruction professional and not scholastic is surely the ideal education for the engineer; yet we must recognize the fact that the graduate from such a course would not be as well fitted to earn his living at the start and would find much more difficulty in obtaining a position than the youth who has spent some time at college in acquiring skill in drawing or laboratory work. Such a course could only be recommended, therefore, to a student with means enough or backing enough to secure the first foothold, without which entrance to the profession is impossible.

Our plea, then, is for wide entrance portals to the engineering profession, for all those who are by nature fitted for its work, no matter whether they be rich or poor, cultured or ignorant. Ample preparation is desirable certainly. Those who enter the gates with less will find themselves handicapped in the struggle. Yet the race is not seldom won by the runner that carries the handicap.

LETTERS TO THE EDITOR.

Driving Long Piles with Short Leads.

Sir: Near the East River, piles 40 ft. long were driven in soft ground. The leads were not adapted to drive piles of such lengths, so a round, straight, perfect shaped pile about 25 ft. long was driven for about 10 ft. and then pulled out. Thus a hole was made of perfect shape to receive the regular pile.

By this means the long pile was easily started and driven straight.

Very truly,

Frank B. McLean.

No. 231 East 31st St., New York City, July 1, 1908.

Column Action in Piles; Stiffening Piles by Riprap.

Sir: Your editorial on "Column Action in Piles" is particularly good except where you give π^2 a value of 10, *ft.* [that was the unaided work of the printer's devil. —Ed.]. The writer's experience has brought him in touch with more than one case similar to the two cited in the editorial and he has often wondered why text-books on foundations did not devote more space to rational pile-foundation design. In this connection he was led to recommend a special note in the standard building specifications proposed by C. C. Schneider, M. Am. Soc. C. E. in a paper before that society some time since, as to the invariable necessity of computing piles as columns even when surrounded by earth throughout their full length (if the latter were at all soft or contained much clay) whenever piles were driven to rock or into a firm bottom stratum.

In marine work, a very common source of such trouble as you mention is the careless location or alinement of piles during driving and the necessity of springing their heads over so as to be covered by a stringer or cap. This results often in giving a single pile and sometimes a whole row or bent of piles, or a whole cluster, a sharp initial flexure. The writer has often seen a line strained almost to the breaking point by the action of a steam pile-driver winch-head, and once received a ducking by the breaking of such a line being used to haul a pile bent over into line.

It is much better practice, too, to deposit riprap filling and drive piles through it, than to do so afterwards, because the latter process has been known to bring such lateral pressures on piles as to cause their failure from flexure.

There are numerous other conditions in regard to which piles should be investigated, besides mere supporting power and column action, which are usually ignored.

Yours truly,

E. P. Goodrich.

1 Wall St., New York City.

Engineers as Business Men.

Sir: As Mr. W. D. Marks shows in your last issue, there are good reasons why engineers should direct engineering undertakings, and there are sufficient instances where possibilities have never been realized because of lack of engineering insight on the part of executives.

But there are also reasons why engineers do not rise to executive positions; Mr. Marks suggests an important one when he says: "There is another point; a technical education does not train one in worldly wisdom as regards human nature, and therefore the engineer is rarely a successful aspirant for public office, for men become unworthy of study in comparison with science."

This view is common among engineers and shows that they know their faults if they would but admit them. Worldly or any other kind of wisdom regarding human nature is as much a part of the "truths of nature" and certainly as worthy of study as are facts about steel and concrete. Engineering is not an end in itself; engineering projects are undertaken only to serve human uses, and they can be carried out only by human means, such as labor, study, conference, organization, contracts, promotion, salesmanship and practically everything included in the terms, business and affairs. Business reasons come before engineering reasons and engineering is carried on for business ends. Engineering is one aspect only; business is the comprehensive view. Engineers must pay the price if they leave it to "business" men to create the opportunities for engineering work.

Whether "unworldliness" in engineers is due to the engineering schools or to engineering traditions or to the evolution of the engineering profession from handicraftsmanship, is perhaps of little consequence; it may be that the "honest plodding toil" of the engineer blinds him to the fact that engineering is only a small part of life and that we should be human first and engineers afterward. By studying people as carefully as engineers study materials and forces, it ought to be possible to develop some capacity for dealing with people. A fuller knowledge of "human nature" should not lead a man to take advantage of his fellows. That is determined by his disposition.

Discipline in exactness, carefulness and thoroughness is undoubtedly valuable in any vocation. To say that an arduous scientific training disqualifies for executive work is to confess limitations. Other professions besides engineering require hard work, but the judge who is worth his salt combines with his knowledge of the technicalities of law a keen appreciation of business factors and of practical sociology. Likewise, applied psychology is useful to the physician, in addition to his knowledge of medicine and surgery. Military men not trained in meeting human situations would fail to utilize fully their technical knowledge of tactics, strategy, arms, fortifications, etc.

Thanks are due to your journal for stirring up this subject. It should help to correct the disgruntled sourness and aloofness sometimes encountered in men who are doing purely technical work. If members of the engineering profession are more capable and upright than business men, let us see that they get the positions of trust, especially in these times when honest men should understand one another and hang together.

Yours very truly,

Geo. H. Gibson.

Tribune Building, New York City, July 3, 1908.

Notes and Queries.

The new aluminum alloy "Magnalium" was in one part of the article on this subject in our last issue, stated to possess under certain conditions a tensile strength of from 2,200 to 5,300 lbs. per sq. in. This error of misplaced decimal points was obvious from the table given a few lines below and should be corrected to read 22,000 to 53,000 lbs. per sq. in.

E. J. R., Omaha, Neb., asks for an explanation of the unequal creeping of rails in the same tracks on the Eads Bridge at St. Louis, as recorded in Tratman's "Railway Track and Track Work."

The principal reasons, probably, are variations in the weight on the wheels and in the grip of the spikes upon the rails. There is nothing to prevent one rail from moving quite independently of the other.

Attention has been directed to an error in the article "Reinforced-Concrete Locomotive-Coaling Station on the Norfolk & Western Ry., at Concord, Va.," in our issue of June 25. On page 690, middle of the third column, "rollers chamfered to admit of lubrication" should read "rollers chambered." This typographical error of a single letter thus somewhat changes the idea of the construction.

THREE MEN WERE KILLED BY GAS in the hold of the wrecked steamer "H. M. Whitney," of the Metropolitan Line, New York to Boston. They had been working on the vessel for a month, raising her from the bottom of Hell Gate Channel, New York Harbor, and had just succeeded. The three men entered the hold to examine it for tightness, but they failed to test the air before they went in, and were overcome before they could be rescued.

THE CONVENTION OF THE AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.

The twenty-fifth annual convention of the American Institute of Electrical Engineers was opened at Atlantic City June 29, following closely upon the meeting of the American Society for Testing Materials. The same fine weather which marked the several preceding conventions at this popular resort contributed no small amount to the success of this convention. An unusually full program was successfully, even brilliantly, carried to completion and this was made possible by having every paper printed in advance, distributed into the hands of every listener and presented in abstract. The convention plunged into serious work after a short address of welcome by Mayor Stoy, in which he extended the freedom of the city for all the waking or the sleeping hours and offered his personal services to all who might have any such freedom denied them. The number of members and guests registered was 469 at the close.

A set of engrossed resolutions was presented to Mr. C. F. Scott, of Pittsburg, Past President of the Institute, for his work in the launching and directing of the plans for the Engineering Societies Building on 39th St., New York City.

The incoming President, Mr. L. A. Ferguson, of Chicago, was introduced and in a few informal remarks he outlined his policy for the coming year. He said that an effort would be made for the Institute to present greater advantages and opportunities to the younger and less experienced men. He hoped that some method could be devised to interest those men who direct large industrial work and who, although not directly engaged on the technical side, could advise and assist very materially on the plans of the Institure. He hoped to work for greater cooperation between the various electrical associations, such as the Electric Light Association, the Association of Edison Illuminating Companies, and the various State associations.

PAPERS ON THE BROADER ASPECT OF ENGINEERING.

THE PRESIDENT'S ADDRESS: THE EVOLUTION OF ENGINERING.—Mr. Henry G. Stott took, as the beginning of the annual presidential address, Thomas Tredgold's definition of engineering, "The art of directing the great sources of power in nature for the use and convenience of man." Mr. Stott presented the theorem that this definition could not hold good today, that it was not broad enough and that, if this definition was accepted as a standard, engineers would not reach that position in society which belongs to them by right of education, achievement and highly developed power of deduction.

Engineers were grouped into two classes; first, those who hold that an engineer's activity should be restricted to the purely technical side of a specific vocation and secondly, those who would have him a prominent citizen, a leader in administration and in large developments. The numerous branches of electrical engineering that exist today were attributed to the need of specialization as a result of the trend of industrial development. It was said that

> this process of segregation is evidently one of infinite application in all pursuits, tending strongly to an ever narrower development of the individual, but at the same time increasing his efficiency to a maximum in his own particular specialty. This increase in efficiency, however, will cease if the engineer becomes so highly specialized as to ignore the necessity of keeping in touch with the entire sphere covered by his company, as the evolution of each branch must be synchronized with that of all.

The class which held to the broader fields of usefulness for the engineer, was described as embracing all who had broadened their working range through self-education, experience, opportunity and natural adaptability. In extension of this idea it was said that

> the engineer who is called upon to report on a projected railroad, for example, must also be a student of political economy in order to give proper weight to the various economic problems which must be first studied before he reports upon the advisability of even making a survey. He should be thoroughly familiar with the general organization of the State governments through whose territory the road may run, as well as have a general knowledge of their laws affecting corporations, franchises, etc. In order efficiently to carry out his work, it will be necessary for him to come in contact with various officers of the state and city governments, so that he should be a man of general and broad culture, capable of meeting any one with credit to himself and the company he represents. Lastly, if he is personally acquainted with some of the more important state or city officials, or the members of the legislature, his work may be greatly facilitated and his services be just so much more valuable to his employer.

Tredgold's definition of engineering evidently did not contemplate this enlargement of the engineer's sphere, and it is only by a natural process of evolution that some have reached this stage.

Obviously the number of engineers appearing in such broad fields of political and administrative work is small for as Mr. Stott found

> whilst the legitimate field of work of the engineer is extremely broad and almost unlimited, yet as a rule he has apparently decided to keep in the background and to come to the front only when called. The result of this policy is that when the opportunity comes, the engineer is taken at his own valuation and passed over for others who, whilst not suffering from modesty, are lacking in engineering education and experience, and therefore are forced to call in engineers (to act in a subordinate position) to supply the incumbent's deficiency in the qualifications necessary for the office.

The blame for this situation was placed greatly on those engineers who, in following the tendency toward specialization did not keep in touch with the general aspects of engineering. The remedy for such a situation given was the advantages of the American Institute of Electrical Engineers, typical among such societies. By this association the specialists were to be brought back to a common ground defined in the constitution of the Institute as "the advancement of the theory and practice of electrical engineering and of the allied arts and sciences."

From the fact that the resolutions proposed through the officers of the four large engineering societies were all reported by the Committee on Resolutions of the recent Governor's conference at Washington, several deductions were made.

> United recommendations after careful investigations of facts by engineers, on any public question involving engineering problems, will be not only courteously received but welcomed and highly appreciated by our state and federal governments. Cooperation on the part of the four national engineering societies is absolutely essential to success in any great economic or engineering movement of national importance; and, as a corollary, success is certain if we cooperate. If engineers are to take the place in society which belongs to them by right of education and training, they must take an active part in matters of general policy or civic interest, no matter how remote these matters may seem from Tredgold's definition of engineering.

Mr. Stott promulgated the idea of having a national association or society composed of members of the four great national societies and whose object would be openly to use all legitimate methods of influencing legislation on matters affecting engineering and engineers, such as for instance the carrying out of measures for the proper conservation of national resources or the application of economic principles in laws affecting public service corporations or commissions. The closing passage epitomized the exhortation of the address:

> Let us remember that if we wish to assume our proper place we must be aggressive and not passive in allegiance to our engineering societies. The day is long past for hiding our light under a bushel. Instead of Tregold's definition of engineering this may more correctly express the position of the engineer today:
> Engineering—The art of organizing and directing men, and of controlling the forces and materials of nature for the benefit of the human race.

ELECTRICITY AS VIEWED BY THE INSURANCE ENGINEER.—Mr. C. M. Goddard, President of the National Fire Protection Association, brought to the convention a picture of the waste of the country's resources by fire and made an earnest plea for the action of the Institute in preventing this economic loss which he characterized as due in fully one-half the cases to utter carelessness—meaning by that, the continuance of conditions easily avoidable.

The magnitude of fire losses ($180,000,000 in 1907, $134,000,000 annual average) was shown by comparison with that familiar measure of financial magnitudes the maximum amount of the national debt, $2,845,000,000. Since 1860 the insurance companies in this country have paid $2,500,000,000 in losses where the total property loss by fire since 1875 has been $4,250,000,000. The 300 odd fire insurance companies now doing business carry risks aggregating $30,000,000,000.

As an argument that American fires should be greatly prevented a comparison of losses in Europe and America was made.

> The annual number of fires in American cities averages 40 for each 10,000 of population as compared with 8 for each 10,000 population in European cities. The annual per capita loss in Austria, Denmark, France, Germany, Italy, and Switzerland varies from 12 cts. in Italy to 49 cts. in Germany, with an average of 33 cts., as compared with $2.47 in the United States.

Mr. Goddard held that electricity applied without the most exacting restrictions was a most serious fire hazard although properly guarded it furnished the safest illuminant and power generators as yet developed. The part of the underwriter in assisting to this much desired end was not forgotten as when it was said:

> I think that no small part of the progress of your art has been due to the fact that in its early days, when the electrical engineer knew little about the fire hazard of electricity, the underwriter, knowing less but fearing much, appeared as an unwelcome but salutary obstructionist and at least caused the matter to be considered and investigated. We must continue our cooperation so that as your art progresses in giant strides, we may together keep pace with it in restrictions which shall not obstruct but safeguard its advance. My great desire has been and is to foster and encourage this cooperation for our mutual benefit; our interests lie in the same direction, we must travel along together and [illegible] up with each others' faults whether we will or not. [illegible]all we not walk as companions rather than enemies?

That part of the paper which seemed to [illegible]he focus of the discussion was especially sugg[illegible]ve and with the discussion may be said to in[illegible]te the course of the Institute's future action i[illegible]is phase of conserving the country's resource[illegible]or the inexcusable annual loss of $90,000,000[illegible]as generally accepted as a waste of resources.

> This is the first time that the National Fire P[illegible]ec-tion Association has been formally represented [illegible]an-annual meeting of this Institute, and it seems t[illegible]me that the time allotted to me in that capacity cou[illegible]ot be better occupied than by endeavoring to show [illegible]a general way why there must be a close relation be-tween the electrical and the fire protection engine[illegible] I could, of course, discuss some particular hazard or [illegible]az-ards of electricity, as a fire producing agent, but [illegible] I can arouse in the membership of this Institute a [illegible]se of the duty they owe, not to the insurance comp[illegible]ies but to mankind in general, so that each will give [illegible]me thought and attention to electrical fire hazard pro[illegible]us, then we can trust to conference committees to wor[illegible]out the details of each and all of the individual problem[illegible]as they arise.

Dr. C. P. Steinmetz crystallized the discus[illegible]on on this paper in saying that the Institute sh[illegible]ld take up the broader field of all the risks inv[illegible]ed in the use of electricity, risks to life and limb, to invested capital and not alone risks involving an immediate fire loss important as that was. He maintained that the Institute should have a committee on this important subject. This committee could make rules of practice or it could secure agitation. Rules might become unduly restrictive and the Institute, he felt, might prefer not to have established rules. It might be preferable to secure the presentation of papers on safe practice and arouse the opinion and demand that only safe practice be used everywhere.

Mr. A. H. Babcock, of San Francisco, related an experience during the great earthquake and fire of 1906. He watched the progress of the fire for a large part of the day from the top of one of the high buildings in the upper part of the city and it was his observation that the fire centers developed were in those districts served by the storage battery system, through underground conduits. In contrast to this destruction there was no serious fire in Oakland, Berkeley, Palo Alto, San Jose or other nearby cities where the shock of the quake alone was equally severe. It was said that the overhead service lines were severed by falling debris so that no electric power was available for service or for damage. Mr. Babcock stated his observation, not in any way as an explanation of the causes of the San Francisco fires but as a most significant occurrence to be examined in studying fire hazards broadly.

A SUGGESTIVE GOVERNMENT POLICY TOWARD WATER POWER DEVELOPMENT IN NATIONAL FORESTS.—Mr. F. G. Baum, of San Francisco, in this paper virtually made an attack on the present policy of the government, as it is commonly understood, as to power development permits, franchises and taxes in national forests. The need for good water power development wherever feasible was quickly passed over as an introduction and several suggestions were put forward for a governmental policy which may be summarized as follows:

> The rights of way and lands necessary should be given in a patent on condition that a certain amount of work be done each year and that a certain amount of construction be completed in five years.
>
> Assuming that the object of the proposed forest-conservation charges or taxes is not for the production of revenue for the government but is for insuring maximum use for all time in producing supplies of food, water, timber, etc., it follows that the different reserve sections must stand on their own merits. The revenue from a California reserve should not assist in purchasing or maintaining a reserve in Maine. The revenue from one reserve should go to protecting and maintaining that reserve alone. Those who have settled in a favorable location should not contribute to the reserves of a less favored situation.
>
> The government should calculate the actual cost of the forest conservation and make the charge accordingly. Rights of way and lands for reservoirs, pipe lines, power houses, etc., should be sold to the developing company at a fair price and should not then enter into the taxes.
>
> The protection of timber growth will generally affect the stream flow and the government may justly charge for this protection. The actual charge must be calculated

for each case and all interests benefited must pay their just proportion. Charges for reservoir privileges, rights of way, canals, pipe lines and station sites should, however, be based on the value of the occupied acreage. A power development on a certain area should make the land no more valuable to the government than if occupied by a quartz mill.

If the charge is based on kilowatt output the man who installs a wasteful plant pays less than one who puts in an expensive and efficient system. The man who transmits this power to a distant market must pay for the losses and expense of so transmitting over what one who supplies a home market is charged, although the first man is equalizing industrial conditions as do railroads by their transportation facilities. He should be encouraged and not taxed for his work.

In contradiction of the view that the government should obtain as large a revenue as possible for every development and should apply the proceeds for the general welfare, basing such views on the contention that the government grants a privilege which cannot be enjoyed by others and should receive a revenue in proportion to that derived by the company from the operation of the privilege, in contradiction of such a view the power companies should not be treated differently from the farmer, the lumber man, the railroad or similar interests. Industry, progressiveness and individuality should not be taxed or stifled.

The discussion on this paper was vigorous, everyone, without exception, differing to a greater or less extent from Mr. Baum's views. The great burden of all the remarks was that forest areas and water-powers are not property of a localized district but that the conservation of the one and the development of the other are matters of moment to the entire country. There was a general consensus of opinion that it was for the greatest good of the greatest population that "spoiled" and hitherto useless water-powers in the East should be assisted to a paying basis of development by revenues on western power privileges as one man would take income from one paying property and use it to bul'd up another poorer property to a paying basis thus making his whole possessions more productive.

Mr. P. P. Wells, of the Forest Service, made several interesting remarks showing the policy of the present administration of the Forest Service in these matters. It was stated that the service fully realized the importance of the greatest and best development of available water powers in assisting the prevention of waste of mineral resources. From this view, Mr. Baum's contention that the charge to the power company shou'd be based on the mere cost of forest conservation was held to be wrong as was also any claim that any other scheme than his would necessarily tax and retard industry, enterprise and progressiveness. The policies of the Forest Service as an administrative body were clearly outlined by Mr. Wells and may be here summarized in four headings:

(1) The Forest Service is not satisfied with the present system of issuing permits for the development of water power on forest reserve lands, revocable at the pleasure of the Secretary of Agriculture. The service would prefer—and indeed has sought legislation to this end—to issue long-term permits, limited franchises or returnable patents to enable full unrestricted development for a single generation only.

(2) In the absence of the desired power the service has gone as far as possible to give certainty to development in issuing permits by fixing the development period as 40 years.

(3) No permit issued shall be held unused. The specific time of beginning and completing construction shall be fixed and the grant shall be lost by lapse of work.

(4) The service stands for a uniform low charge or rental based on actual development. The value of a development is to the whole people not to a local group. The charge should be based (a) on the value as a power site of the lands occupied, (b) on the resources utilized—water, timber, etc., and (c) on the service rendered in conserving the value of the power for future times.

Mr. Wells contended that Mr. Baum's analogies were faulty. For instance, the case of the farmer was cited. The policy of the government has been to give free homes to establish a population. The government held that the country received ample compensation and had its interests advanced by such colonization. The present administration would not extend this principle to corporations not establishing population but working primarily for private gain. The grazing fees in forest reserves were an attempt at a return on the actual grazing value of the land. Saw mill sites were charged on a basis of mill capacity. The charge for actual water conservation was not based on the amount stored on forest lands, but on the head obtained through the conservation service.

Dr. C. P. Steinmetz in commenting on this paper maintained that considering the development of a water shed as a local matter was a vicious sentiment directly against the objects of setting aside the forest reserves. The only excuse for the government conservation of the forest and streams was that their use was not of mere local importance.

He brought forward the idea that wholly local expenditure of revenue from local development would not broadly conserve water powers where there was not enough prospective profit to interest private capital. This would be an inefficient way of protecting the country's resources as a whole.

This speaker also brought up the feasibility of Mr. Baum's scheme. The ability to get long term and perpetual franchises is becoming rare, as public sentiment is changing. The life of future franchises generally, it was held, would be the life of a single generation, 40, 50 or 75 years. To attract private capital with a short-term franchise is a problem which Dr. Steinmetz would see solved by guarding the investor against any form of confiscation of invested capital at the end of the franchise period.

TELEGRAPHY AND TELEPHONY.

WIRELESS TELEPHONY.—A rather long but interesting paper by Mr. R. A. Fessenden, of Washington, D. C., was presented in abstract. In this contribution a history of wireless telegraphy and telephony was built up from its earliest days to the present; from 1838, when Joseph Henry first produced high frequency electrical oscillations by the discharge of a condenser, through the discoveries and deductions of Helmholz, Hertz, Lodge and through the developments of Crookes, Hughes, Dolbear and Marconi.

Up to 1898 the work had been entirely with damped waves—those oscillations the strength of which rapidly died out—received on what the author called "microphones"—loose aggregations of metallic or conducting particles that changed their effective resistance when placed so as to obstruct the ether waves. From 1898 on, a different line of investigation and invention was undertaken. Now sustained electrical oscillations were sent out and were received on several types of apparatus fundamentally different from the coherer or "microphone." The continuous high frequency oscillations were produced by arcs and by straight or dynamo transformer arrangements.

Out of the work with sustained oscillations wireless telephony grew and the author stated three necessary features of apparatus for such transmission of intelligence.

1. Means for radiating a stream of electrical waves sufficiently continuous to transmit the upper harmonics on which the quality of the talking depends.
2. Means for modulating this stream of waves in accordance with the sound waves.
3. A continuously responsive receiver giving indications proportional to the energy received, and capable of responding with sufficient rapidity to the modulations in the wave stream to produce speech harmonics.

Mr. Fessenden then gives in considerable detail a description of the apparatus, used by him, in producing the wave stream and the transmitters that fluctuate the amount of energy transmitted in the wave stream as well as the "barreter," or bolometer modifications used to convert these energy changes into sound waves.

It was the author's expressed belief that there was a good field for wireless telephony where long distance lines are now used and for transmarine communications with fixed or moving stations. The trials and tribulations of inventors and promoters of wireless systems in fighting what they have termed "governmental obstruction and confiscation" are set forth at considerable length. It was claimed that it was practically impossible to secure a permit to erect a station in any foreign country for communication to this shore, no matter how great and varied commercial interests were served. It was claimed that the government was seeking to establish a monopoly in American wireless telegraphy, that it had made use of patented inventions for the Navy Department without any consideration or compensation, that it was attempting to establish certain wave lengths and receiving rights that would limit private long distance transmission to the night hours and to such times as neighboring naval vessels might allow irrespective of any interference preventors which might be developed.

MULTI-STATION AUTOMATIC TELEPHONE SYSTEMS.—This study by Mr. W. L. Campbell, of the Automatic Electric Co., La Grange, Ill., showed the great economic waste of material and the vast idle capital in telephone cables running from central stations to subscribers' instruments by having these cables in infrequent use. The factor of greatest cost in the equipment of a telephone system was given as the lines, in many cases amounting to two-thirds the first cost of the whole system. It was stated that in a single-station system at the peak of the load that 90% of the lines were inactive and that the average of the 24-hour period showed 98% inactive. The problem attacked was to minimize the amount of idle line equipment, without impairing the service and thus to effect a reduction in rates that would extend the benefits of the telephone. The method outlined by the author for the reduction of the amount of idle lines was to carry the sub-division of central stations, connected by trunk lines to the extreme which economic and service requirements would allow. By a comparative study of the manual and automatic systems, from the author's standpoint, it was shown possible to subdivide the automatic-system grouping into outlying sub-stations having in some cases a capacity of only 100 lines. On these grounds the manual system required a minimum capacity of some 1,000 lines. The author's position is shown below:

One of the peculiarities of the telephone business, especially when there is competition, is that an operating company is compelled to take on the new business offered. It must keep up with its rival or drop out of the race. A user of electric light doesn't care how many other customers are connected to the same plant that he is, but a telephone user is, of course, very much attracted by the larger of two lists of subscribers.

A one-office telephone plant sometimes must be almost entirely rebuilt within a few years of its installation in order to adapt it to a shifting of population, or to make it adequate for the customers unexpectedly demanding service.

With a multi-office automatic system this need not be done. If an unexpected demand for telephones develops in a certain section of the city, it is not necessary to put in more conduits and cables or to replace present cables with larger ones to take care of the demand, but the situation is readily and practically met by putting in a substation or a branch office in the congested district. The present line cables running to the district may be used as trunk cables to the new office. Thus the traffic carrying capacity of the cable and conduit plant reaching any district may be greatly multiplied without any additional expenditure for cable or duct. Consequently, one of the most attractive features of an automatic multi-office system is that it affords a stable value to the investment in wire, cable and conduit.

HIGH-TENSION POWER-TRANSMISSION PAPERS.

EXPERIMENTAL STUDIES OF LIGHTNING.—Mr. E. E. F. Creighton presented a paper which embodied an outline of methods and results of studies into the characteristics of lightning and into the design and operation of lightning arrestors. A brief abstract of this paper appears elsewhere in this issue.

TESTS WITH ARCING GROUNDS.—It has long been common knowledge that more or less abnormal voltages existed in generating or transforming apparatus by an arcing ground on the transmission lines. Mr. E. J. Berg, of Schenectady, described a series of tests undertaken in hope of deducing a mathematical expression for this action on transformers. The mathematical expression could not be deduced but the results were presented without explanation of any kind. It was found that a voltage, sometimes a hundred times normal, existed at the time of such grounds, in the few end turns of a transformer rendering it very liable to damage. It was found that this stress could be relieved by making a good ground connection of the line giving the trouble until the actual line trouble could be located and repaired. This scheme applies of course only to such transmission systems as can safely be grounded.

THE DESIGN OF TRANSMISSION LINE STRUCTURES.—Mr. D. R. Scholes, of Chicago gave some interesting comparisons of tower designs with windmill tower practice. This paper is reviewed in another part of this issue.

TESTING OF INSULATORS.—Mr. C. E. Skinner, of Pittsburg,, proposed some standard specifications for testing high voltage insulators, built up of recognized practices by various persons and concerns. It was held that at the present it was impossible for a person familiar with one certain method of testing to judge the bearing of results of some other system. The specification was divided into: (1) routine tests, to show defects in material and workmanship; (2) design tests, to show limitations of the design; (3) methods of testing.

The first division was made up of the requirements of a mechanical inspection and a test of dielectric strength. Each part of a built-up insulator was to stand, for five minutes, three times its proportion of line voltage. The completed insulator was to stand 2½ times normal voltage for five minutes.

The second division included tests of mechanical strength and of dielectric tests under artificial rain and dew. Two clauses on the latter are appended.

Dew Test. With the insulator cooled to 0° C., or below, and then placed in a moist atmosphere of 30° to 40° C., it shall withstand 1.25 times the normal line voltage after the insulator has become thoroughly covered over its entire surface by the condensation of moisture from the atmosphere.

Rain Test. The rain test shall be made by mounting the insulator on a metal pin or equivalent, so arranged that it may be placed either vertical or at an angle of 45° to the vertical. Clean water shall be used and the precipitation shall be such that the water falls in a fine spray and in practically a vertical direction and at a rate of from 0.2 in. to 0.3 in. per minute, over the area formed by the vertical projection of the insulator. The rate of precipitation shall be obtained by the use of a suitable rain gage of not more than 3 ins. in diameter.

In the discussion of these specifications Mr. R. D. Mershon said that such recommendations were advisable to secure a more uniform basis of comparison. The vertical rain and tilted insulator were approved as being more exactly reproducable than the vertical insulator arrangement with rain driven by fan or otherwise.

Dr. C. P. Steinmetz proposed immersing the insulators for several weeks before testing to bring out the absorption in cracks and imperfect vitrification.

HIGH VOLTAGE EXPERIMENTS AT NIAGARA FALLS.—One of the most interesting papers of the whole convention was the report of Mr. R. D. Mershon on studies of losses between conductors and over insulators of a transmission line. This work was an extension of that carried on near Telluride, Colorado, in 1897. It became possible in 1903 and 1904, through the generosity of private interests, to take up the work at Niagara Falls.

Two experimental systems were built up. One called the "experimental line" was described as having

a total length of 2,000 ft., although, generally, only half its length was used. It was supported upon wooden poles, spaced about 140 ft. apart. At first, the line wires were supported upon insulators, but it was found that the loss over the insulators was so great and so variable that if any reliable results were to be obtained, it would be necessary to find some other way of supporting the line conductors. Finally, the line wires were suspended by means of paraffined cords attached to the necks of the insulators. As long as these cords were clean, the loss over them was negligible. As soon as they became dirty, they were replaced by clean cords.

An additional short line, known as the "Dummy Line," only a few feet long, was made with several cross-arms with proper pins and insulators. The loss on this line was due to insulators only.

Two single-phase, 100,000-volt transformers were used, each of a capacity of 10 KW. The power was from an old-type surface-wound, 133-cycle, single-phase alternator run at half speed. This machine gave nearly a sine wave under all conditions. Current was sent out onto the experimental and dummy lines and the losses were determined by a method devised by Mr. Mershon in 1897.

In it the iron-loss of one transformer is balanced against the iron-loss of both transformers in such a manner that no iron-loss reading appears on the wattmeter, with the result that the wattmeter records only the losses in the high-voltage circuit of the transformer feeding the line. By this method of measurement the only correction which it is necessary to make in the wattmeter reading is to subtract from such reading the $I^2 R$ loss in the high-tension coil of the transformer feeding the line.

Mr. Mershon's paper describes in considerable detail the difficulties encountered, the progress of the work from time to time and the interpretation of results. At this time only a brief summary of the more important conclusions of a practical nature can be given. These results include also the consideration of work done previously by Professor H. J. Ryan:

(1) With a given conductor at a given spacing and under given atmospheric conditions, there is a certain voltage or "critical point" at which a very appreciable loss begins to occur through the atmosphere. There may be an appreciable loss existing below this critical point, depending upon the atmospheric conditions. The presence of floating particles in the atmosphere may produce a loss below the critical point.

(2) The presence of moisture in the atmosphere may produce a loss below the critical point. The presence of moisture in the atmosphere affects the loss both above and below the critical point. The presence of moisture or floating particles in the atmosphere affects the position of the critical point.

(3) The critical point corresponds to a partial breakdown of the dielectric. The critical point coincides with the voltage at which luminosity or hissing (or both) of the conductors begins. The critical point depends upon the maximum value of the electromotive force wave and the distance between the conductors. The critical point depends upon the local rate of fall of potential or dielectric stress at some point in the atmosphere and, therefore, depends not only upon the maximum value of the electromotive force wave and the distance between the conductors, but also upon the diameter of the conductors.

(4) There is a loss over insulators which is affected by the moisture conditions of the atmosphere. The variation of the atmospheric loss between conductors, the variation of the loss over insulators, and the variation of the critical point due to the moisture conditions of the atmosphere bear to the "vapor product" (I. e., the product obtained by multiplying the vapor pressure by the relative humidity) a definite relation which, so far as is at present known, is an empiric one. The loss over insulators in a fog is very much higher than the loss in dry air, and somewhat higher than that in a heavy rain. The smoother the surface of the conductor, the less the loss and the higher the critical point. The stranding of the line conductors reduces the loss and raises the critical point due to the increase of the equivalent diameter of the conductor. The increase of the equivalent diameter of the conductor is greater the greater the number of strands.

(5) The weathering of conductors (or at any rate the aluminum conductors and probably copper also) does not appreciably increase the loss or lower the critical point The loss and critical point are the same for copper and aluminum under the same conditions.

(6) Anything which increases the charging current of an insulator increases the loss over the insulator. The loss over an insulator on a wooden pin is greater than that over an insulator on a metal pin, because the resistance of the wooden pin is in series with the charging current of the insulator.

(7) The atmospheric loss between conductors and the loss over insulators decrease with the frequency. The law of the decrease is not at present accurately known.

(8) Neither the critical point nor the loss between cables is affected by variation in the distance of the cables from the ground.

In the discussion, general gratification was expressed that private generosity should have been able to make possible such studies of the limitations, and their causes, of high-tension electric power transmission.

Mr. Elihu Thomson, of Lynn, Mass., said that the effect of moisture shown by Mr. Mershon's experiments might be explained by considering that water vapor just above the condensation point was not a true gas, but that some particles might lose velocity and exist for a time as liquid. These floating particles of liquid then act exactly as the floating particles in Mr. Mershon's statements immediately preceding. Mr. Thomson maintained that the relation between losses and "vapor product," while an entirely novel one, could be explained by the action of water vapor as an imperfect gas. The reduction in loss by stranding was unexpected and later study might reveal some new ideas.

Dr. Samuel Sheldon, of Brooklyn, N. Y., said that recent experiments had shown that the air at Providence, R. I., and Block Island contained free ions. He claimed, moreover, that it had been determined that impact was nec[illegible]y to ionize air and that ionization once start[illegible]read like wildfire. Just this action might be [illegible]ected to occur at Mr. Mershon's "critical po[illegible] and it would explain that phenomenon for a[illegible]ough not for insulators.

Dr. C. P. Steinmetz suggested that if th[illegible]urves exhibited to show the critical point of br[illegible]down were plotted with the logarithm of absci[illegible] and ordinates as new abscissae and ordina[illegible] that straight lines might be produced to show [illegible]e intersection (critical point) more definitely.

The report of the convention papers a[illegible] discussions on electric railroading, design [illegible]ma-chinery and technical training will be pri[illegible]d in our next issue.

MEASUREMENTS OF LIGHTNING, LIGHTNING ARRESTERS, EARTH RESISTANCES, CEMENT RESISTANCES AND KINDRED TESTS.*

By E. E. F. CREIGHTON,† Assoc. Am. Inst. E.

The experimental measurements to sup[illegible]ment laboratory investigations reported in this [illegible]aper were made on the lines of the Animas P[illegible]er & Water Co., and the Pueblo & Suburban L[illegible]ht & Power Co., both well up in the Rocky Mo[illegible]tains of Colorado. The term "lightning" has he[illegible] been used to designate a broader class of phen[illegible]mena than is ordinarily meant by that term. Its use covers transient electrical phenomena gen[illegible]rally.

CHARACTERISTICS OF LIGHTNING.—Before a lightning-arrester can be designed along logical lines the characteristics of the discharge which may pass through it must be known.

In considering the design of lighting-arresters, a brief classification based on the effects of lightning may be made as given below. The principal factors involved are: (1) Duration of the surge of lightning. (2) The potential values of the lightning. (3) The maximum current discharge rate. (4) The natural frequency of the lightning. (5) The quantity of electricity in the lightning stroke. In considering the choice and operation of arresters for a transmission line, the most important of these factors is the duration of the surge.

DURATION OF LIGHTNING.—Lightning from an external source (cloud lightning) is usually of very short duration. Measurements made during the summer of 1907 in Colorado, gave a range of 0.04 sec. to 0.0001 sec. Cloud lightning has been known to continue for longer than one-half a second in rare cases. Lightning from an internal source (accidentally grounded phase, switching, etc.) often continues over a period of several minutes, or even several hours.

Lightning frequently recurs in successive strokes. A number of measurements were made on an idle line which gave as high as seven separate discharges in one second. In the lightning-arrester these multiple strokes give the effect of long duration.

One notable piece of apparatus was developed to measure duration. In this a spark gap was arranged in front of a rapidly revolving photographic film. Light from the discharges was allowed to fall upon the film through an aperture in a screen and knowing the speed of rotation the duration was measured. During storms 36 discharges were studied; of these two were expressed in terms of hundredths of a second, 17 were in thousandths and 16 were in ten-thousandths of a second.

Each exposure showed broken line representing the frequency of alternation of discharge. This frequency of about 3,000 cycles per second was analyzed further into a higher frequency by a "frequency meter." This latter piece of apparatus consists of long vertical wire coils having one end connected to the line and the other end dead. The reflection of the waves from the dead end of the coil produces interference effects on the incoming waves which action causes high potential points along the tube which are recorded on a photographic film between the tube and a parallel antenna.

Natural frequency of lightning should not be confused with the multiple stroke or the frequency of recurrence of strokes. Frequency is distinguished by analysis under four heads.

1. Lightning strokes often come into a station during a storm at an average rate ranging from two per minute to one in five minutes.

2. Each of these flashes, which appears to the eye as a single flash, may often be two or more distinct

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succe e strokes distributed over a second or less. In the paragraph the analysis of each of these indi- vidu rokes into oscillations gives the natural fre- quen of the discharge.
3. y of the discharge records of the rotating-film app for measuring duration are in the form of a unif broken line whose parts correspond to the half es of the discharge current. This frequency, whe existed, was of the order of the natural fre- quen of the transmission line, about 3,000 cycles per secon
4. h one of these waves may be made up of higher freq ies superimposed upon it. Of these high fre- quen the only ones measured were of the order of a milli ycles per second.

T elative severity of lightning strokes is indic by the weight of the fuse wire blown but fuse itself gives no good indication of the qua y of electricity passed. The factor of dura enters and this depends on the damping of osc ions by resistance, the dissipation losses and the initial potential. The apparatus for mea ing the quantity of current consists of a dup on recorder in series with three magazines of fuses. All the fuses in one magazine are of one size, but the three groups are graded. The fuses can be calibrated if desired with an oscillograph, measuring current and time. In some cases a hot-wire ammeter can be used if properly calibrated. The data from one test, that of a heavier stroke than the average, showed a value of 0.032 coulomb for the quantity passed.

BEHAVIOR OF GROUND CONNECTIONS.—The experiments on ground plates and pipes showed that, with a dynamic current being discharged to earth (as contrasted with the relief of the lightning phenomena), the resistance increased after a short time. This was evidently due to the evaporation of water by the heat produced. The normal resistance returned after a period of rest. Any kind of a metal pipe or rod makes a good ground connection if driven in a few feet and if the soil around the top is cupped away and filled with a few pounds of common salt which is afterward well watered.

LIGHTNING PROTECTION FOR BUILDINGS.—The customary lightning conductor is usually connected to a single earth by a single conductor. Numerous cases of side flashes from the rod into some part of the building have been recorded. The following recommendations based on minimum inductance and screening are made:

Assuming a pointed roof for simplicity of illustration, a rod should be carried up high enough to act as an electrode for the lightning arc probably 6 ft. or more, basing the distance on photographs of the part of the rod rendered luminous by the lightning. From a point about midway up on this rod, at least eight copper or iron wires should be attached; a wire passes to each corner of the roof and one at each midpoint. Each wire is carried directly down to a salted pipe-earth. At the eaves a horizontal metallic connection should be made to equalize the potentials and again at the ground line. The natural inclination of high frequency currents to spread over a surface will tend to prevent a side stroke toward the interior of the building. The multiple earth will tend to equalize the potential over the entire building. With a given amount of copper, the more it is subdivided into multiple paths, the surer the protection. The foregoing is intended to cover only the principle involved and will have to be altered somewhat to meet architectural demands.

CEMENT AS A RESISTOR.—Some time ago the possibilities of trouble with lightning-arresters on a system using cement resistors between the neutral of the system and ground suggested the necessity of studying its characteristics.

Another important phase of the subject is related to the use of cement in poles and as anchors or foundations for electrical transmission towers. In the event of a shattered insulator, the cement or concrete will be called upon to carry either the charging current or one phase according to the connections. In this case the question of conductivity is a minor matter and attention should be directed to the possibility of disintegrating the cement by overheating. A series of tests was carried out to determine the suitability of Portland cement as a material for resistances, especially its use with large currents and on high voltages. They tend to show the following conclusions:

The tests made with cement rods having different proportions of sand show a progressive increase in resistance with increase in the amount of sand, leading to the conclusion that the sand acts practically as an insulator distributed through the cement, so diminishing the effective cross-section of the rod.

All the experiments on the change in resistance with age or with heating indicate that at moderate temperatures the conductivity depends almost entirely on the amount of contained moisture. It would appear probable that the moisture dissolves a portion of the cement to form an electrolyte which being diffused through the body of the cement conducts the current, the solid part of the cement simply acting as a container for this electrolyte.

The studies of concrete while not as complete appear to agree with these conclusions.

The experiments on resistance at high temperatures and at high voltages show that cement possesses in addition to its low temperature or moisture conductivity a high temperature or pyro-conductivity. Also that a high voltage is able, in some manner to bridge the interval of high resistance and raise the material to incandescence.

FUNDAMENTAL CONSIDERATIONS GOVERNING THE DESIGN OF TRANSMISSION-LINE STRUCTURES.*

By D. R. SCHOLES, Assoc. Am. Inst. E. E.†

A forecast of the statement of loads, for which a tower or pole must be designed, is based on a forecast of probable extreme weather conditions in the vicinity of the proposed line and also on a prediction of probable accident to the conductors.

The cost of a line is affected very largely by the figures which are selected to represent the probable extreme conditions, and the selection and application of these figures is, therefore, a matter of a good deal of importance. Unfortunately, data on this subject are very meagre, and a rational solution of a problem involving weather conditions and possible accidents is manifestly impracticable. It seems, therefore, that the best guide in selecting figures to represent the probable extreme load conditions is experience with existing transmission line structures and other structures similar to them.

The forces which may come upon a transmission-line structure result from wind, sleet, low temperature, accidents to cables, etc. A factor of safety must be selected and a study made to determine whether loads may come on simultaneously from two or more of these causes.

Steel windmill towers have been in general use now about 18 years and the success of a given design depends on the integrated experience with all such towers. Competition has brought the weight of such towers to a minimum and it is probable that a standard design of windmill tower has just about strength enough to resist the highest winds, tornadoes excepted, and study of such a tower should give some useful data for transmission-line structures.

An examination of a standard design of windmill tower shows that such tower will actually fail under loads calculated on the basis of wind pressures of from 40 to 50 lbs. per sq. ft. The tower referred to is of square pyramidal form, and in the calculations it is assumed that the wind is blowing at right angles to one side, and both faces of the tower are considered equally exposed. It appears, therefore, that it would be good practice in transmission-line construction to specify that the poles or towers should, in addition to their other properties, have strength to resist loads on their members due to a wind pressure of 40 lbs. per sq. ft., with a factor of safety of from 1.5 to 2, based on actual test. Such a structure would be suitable for locations where the winds are high; in other locations these figures would be reduced by judgment, aided by a consultation of the weather reports and other such data.

FACTOR OF SAFETY.—In designing a complicated structure to sustain a complex loading, a large factor of safety is natural and proper, particularly if the structure can not be tested to destruction. However, with a simple structure carrying definite loads a smaller factor would be equally safe if the ultimate strength of the structure had been actually determined. With the simple structures used on transmission lines and with the experience gained with windmill towers the uncertainty surrounding the figure, 40 lbs. per sq. ft., is largely removed.

WIND PRESSURE ON CABLES.—In the absence of specific data relating to wind pressures on the cables of long spans, it seems unsafe to assume a pressure of less than 30 lbs. per sq. ft. for localities where the winds are known to be high. The figure 30 lbs. per sq. ft. is commonly used in bridge calculations for surfaces extending through horizontal distances of 60 ft. or more. It seems that a factor of safety of 2 should be used in connection with this pressure, so that the conductor will not be stressed beyond its elastic limit, under extreme conditions.

SLEET.—Destructive sleet storms occur as far south as Georgia and local conditions have to be studied. As the result of experience and study it appears that, where sleet is known to form, a coating of ice ½-in. thick should be figured for with a factor of safety of 2 based on the ultimate strength of the conductor.

ACCIDENTS.—In providing mechanical strength in the line to resist loads due to accidents to the cables, there are two well-known plans which may be followed. In the one all structures are given the same strength, each having strength to withstand the loads due to accidents which it is contemplated may occur in any span; in the other plan, two kinds of structures are used—a standard structure intended to support loads transverse to the line only, and a heavy structure having strength against the breaking strength of all the cables. These heavy structures are distributed along the line at intervals of a mile or so. The first mentioned type of construction is best adapted for lines having relatively small conductors, while the second type is favorable where the conductors are heavy.

In designing a line of the first mentioned type it is usual to assume that any two conductors may break in a given span due to the formation of an arc between them, and that the tower or pole should be capable of withstanding the loads so developed without damage to itself. Provision is not, in general, made

It is believed that the factor of safety used in connection with the loads due to breakage of conductors should be greater in the case of suspension type insulators than with pin insulators. When a conductor supported by suspension insulators breaks, it will suddenly move away from the point of breakage and will be brought to a sudden stop when the insulator comes into line with the cable. The movement will occur, in decreasing amount, all along the line, or until a strain insulator is reached. This sudden application of load and the attending inertia effect will subject the crossarm to a greater force than the tension which existed in the cable before it broke. It is suggested that crossarms be tested to loads equal to 1.25 times the elastic limit of the conductor for pin insulators and 1.5 times the elastic limit of the conductor for suspension insulators.

FOUNDATIONS.—The usual assumption is that the resistance to uplift is the weight of the foundation plus the weight of earth in the frustum of an inverted cone whose sides are inclined to the vertical from the edge of the foundation at an angle of 30°. The results of this assumption agree closely with windmill practice. Local soil tests, however, should be instituted to bring the strength into a known relation to the rest of the line.

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SOME ENGINEERING FEATURES OF THE SOUTHERN POWER COMPANY'S SYSTEM.*

By J. W. FRASER,† Assoc. Am. Inst. E. E.

It has been aptly stated that in order to build a hydro-electric power system there are three fundamental requirements:

1. A sufficient source of power.
2. A market for the sale of power within economical transmitting distance.
3. The necessary capital.

A concrete example has been taken to show how the conditions governing the sale of power must affect the design of a system. The various power sites aggregated a capacity of 150,000 HP. Of these only one had been developed—that at Catawba Station, 10,000 HP. The others are scattered along the Catawba River for 120 miles.

The area to be served contains the largest number of cotton mills in any similar area in the South, representing a requirement of some 200,000 HP., all within easy transmission distance of the water power sites. Three-fourths of these mills used steam power, where the average cost of power was $34 per B. HP.-year of 3,666 hours. With coal at $3.50, power could not be distributed for less than $28 from large stations.

True it is that in recommending investment in these sites it had to be considered that although the electric drive had demonstrated in some instances its reliability, convenience and economy yet the unsatisfactory history in other instances, the general impression that power was produced for much less than it actually cost, and the fact that mill owners were averse to further investment, would make the sale of power a difficult matter. Still the main question which interested the investor was the cost of steam power, for prejudice could be overcome and the real cost of power could be demonstrated.

FREQUENCY.—In determining the frequency of the current to be supplied, account had to be taken of unusual local conditions. The 60-cycle

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generators in the 10,000-HP. plant at Catawba Station and some 10,000 HP. in induction motors would have to be rewound if a lower frequency were selected for the new development. Some 8,000 HP. of 60-cycle motors were distributed in the new territory. There were several small city plants operating on 60-cycles which might be enlarged if this frequency was employed. The 25-cycle generators, transformers, etc., would have cost from 10 to 25% more than the 60-cycle.

These considerations seemed to favor 60 cycles, but as exact figures were necessary in this case the following rough calculation was made: the saving in cost of generators and transformers amounted to $75,000; and if the saving in copper due to increased power factor is added the total will be in the neighborhood of $100,000.

There is an additional loss of about 10% of the loss which there would have been at 25 cycles and the integrated loss over the present lines when fully loaded will be in the neighborhood of 27%. In power this amounts to 10% of 27% of 26,000 KW. = 700 KW., which at $5 per KW. is $3,500.00. Capitalized at 6% this amounts to $60,000—a balance of $40,000 in favor of 60 cycles. It is possible that a very careful analysis might show this loss to be a little greater but the error cannot be over 25%, as the integrated loss referred to has been taken over a period of six months and covers losses from generators to meters on load.

VOLTAGE.—It was found advisable to keep the voltage down to 44,000 for several reasons, among which may be mentioned: (1) the 44,000-volt transformers would cost from 18 to 33% less than for 66,000 volts, (2) the insulators would cost about 80 cts. less each, (3) the transformer, switch and line operation would be more reliable, and complete reliability was necessary.

TRANSMISSION LINES.—Through the impossibility of making contracts with mill owners, due to their skepticism, the estimates of load for any section could not even be estimated to determine the size of transmission lines. Partly on this account it seemed good practice to build main trunk lines of steel towers and all single lines below No. 0 gage of wood poles. One other factor increased the difficulty. Several other power developments in this region were being financed by competing companies which tended to make mill owners hold out for lower rates.

SUBSTATIONS.—The first motors installed were for 550 volts, but it was soon seen that this practice involved too many small substations with a complicated operation and excessive cost. After some investigation 2,000-volt motors were recommended for all mills converting to electric drive. To-day over one-half of the total horsepower in motors is at 2,000 volts. This voltage allows all mills within a radius of two miles to have a common substation. Most of the substations below 900-KW. capacity are wholly or partially owned by the customers. The power company usually buys and instal's the apparatus, selling to the customer at minimum cost. The company discountenances buying transformers of less than 200 KW. on account of the high cost per kilowat capacity of the completed station.

SECONDARY POWER.—The flow of the Catawba having been well determined for many years the problem presented itself of developing for 12 months at average minimum flow, or for an increased power for eight or ten months with steam supplementary power. Weighing all the conditions it was found advisable to develop the water-power site for 150% the minimum. The deficient power will be supplied at low water by steam plants in the proper centers or by the mill owners themselves, who have eight-month contracts with the power company.

AIR LEAKAGE IN STEAM CONDENSERS: A PLEA FOR SCIENTIFIC CONSIDERATION OF THE SUBJECT.*

By THOMAS C. McBRIDE.†

Experience has shown that the presence of a small amount of air in a steam condenser has a marked effect upon its capacity and efficiency. In spite of this no serious attempt seems to have been made to determine quantitatively the amount of air mixed with steam in ordinary practice, nor definitely to define or limit this amount to exact figures in condenser contracts and guarantees.

If it can be demonstrated that

(a) The greater part of the air coming to condensers is the result of air leaks, and

(b) That these leaks are mostly in the prime mover and its connections and likely to be but small in amount in the condenser itself due to the difference in the character of the two structures;

and,

(c) If it is possible to devise some convenient method of estimating the proportions of the air to the exhaust steam required to be handled by the condenser,

then, it is only as fair to expect that purchasers' specifications shall at least limit the amount of air to be handled by the air pump, that the manufacturer may intelligently select the size of this pump, as it is to expect these specifications to state the amount of steam to be condensed, that the manufacturer may properly determine the size of the condenser.

In view of the one-sidedness of the usual purchaser's specifications in this regard, it is not surprising to find the manufacturer in turn exacting a condition in his proposal that the prime mover and its piping shall be "free from air leaks" and then furnishing an air pump costing a very appreciable fraction of the total plant cost to remove air specified not to be present.

The author believes and assumes that the amounts of air passing through different condensers may be best measured and compared on the basis of the relation of the volume of this air to the volume of the steam being condensed, both being at the pressure and temperature existing in the particular exhaust pipe. The most convenient unit of volume is the volume of the water of condensation coming from the steam. The ratio of the volume of air passing through the air pump to the volume of water of condensation is then used to measure the air.

The most reliable index of the proportion of air to exhaust steam customary in existing plants is to be found in the ratings of air pump capacity in general use.

Manufacturers of vertical twin air pumps and surface condensers usually guarantee them for 26-in. vacuum (30-in. barometer and 110° F. hot well temperature, with 70° injection and 110° discharge temperature, under which conditions it is customary to furnish an air pump of a displacement of about 13 times the volume of the water condensed.

Presuming that the friction of the vapors in passing through the condenser is negligible and that the volumetric efficiency of this type of air pump is the same for the air as for the water, this rating presumes that for every unit volume of water of condensation there will be present in the air-pump suction pipe 12 volumes of air, saturated at 26 ins. and 110°, at which temperature the pressure of the steam alone is 2.58 ins. absolute.

The 12 volumes of saturated air in the air pump suction pipe is made up (Dalton's Law*) of

12 volumes of steam at.....2.58 in. absolute
12 volumes of air at.....1.42 in. absolute

Total pressure .....4.00 in. absolute

Reduced to the condition in the exhaust pipe, that its volume may be comparable to the volume of the exhaust steam, this air alone becomes (according to the well-known laws of the relation of temperature, pressure and volume of gases)

$$12 \times \frac{1.42}{4} \times \frac{459.5+125}{459.5+110} = 4.37 \text{ volumes.}$$

*Dalton's Law as it relates to steam in condensers has been explained by the author in a paper delivered before the Engineers' Club of Philadelphia, thus:

Exhaust steam as it exists in practice in condensers and their piping does not conform to the steam tables because of the admixture with it of certain amounts of air. The temperatures and pressures of this mixture of air and steam follow Dalton's law. Under this law the total pressure at any point is the sum of the individual pressures of the air and of the steam in the mixture at that point, whereas the temperature is that due to the steam at its individual pressure as if alone. In most condenser problems making use of this law the temperature and the sum of the individual pressures are given, the latter being the absolute pressure in the condenser. The individual pressure of the steam will be that due to the temperature and can be taken from the steam tables. The individual pressure of the air must then be the difference between this individual steam pressure and the total pressure. Having obtained these individual pressures, and knowing, therefore, that the relative volumes of the air and steam, if separated, must remain in the same proportion as their individual pressures, it is possible to calculate the exact amount of air present and to trace this amount through the condensing process.

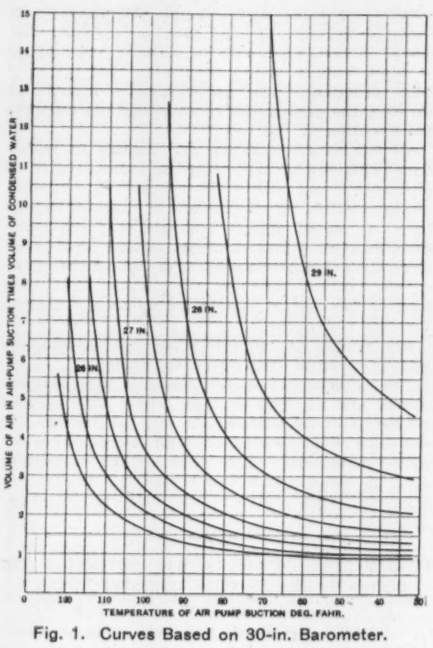
VOLUME OF AIR IN AIR-PUMP SUCTION TIMES VOLUME OF CONDENSED WATER
29 IN.
28 IN.
27 IN.
26 IN.
25 IN.
TEMPERATURE OF AIR PUMP SUCTION DEG. FAHR.

Fig. 1. Curves Based on 30-in. Barometer.

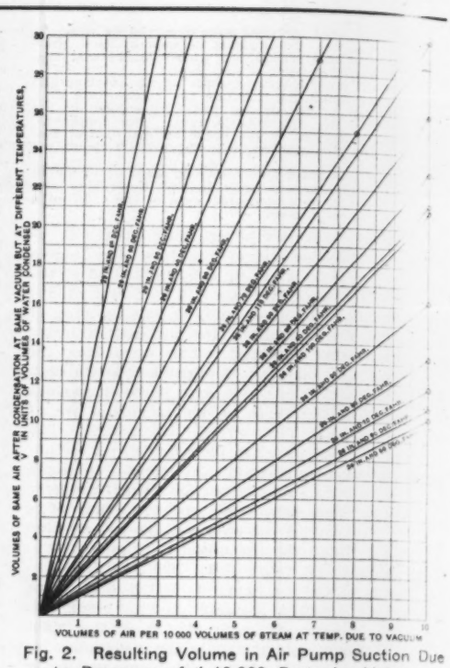
VOLUMES OF SAME AIR AFTER CONDENSATION AT SAME VACUUM BUT AT DIFFERENT TEMPERATURES, IN UNITS OF VOLUMES OF WATER CONDENSED
VOLUMES OF AIR PER 10 000 VOLUMES OF STEAM AT TEMP. DUE TO VACUUM

Fig. 2. Resulting Volume in Air Pump Suction Due to Presence of 1-10,000 Parts by Volume of Air in Exhaust Steam.

TABLE I.—RESULTS OF FOUR TESTS ON LARGE SURFACE CONDENSER.

Test number	1	2	3	4
Ratio steam being condensed to guaranteed capacity of condenser for 70 deg. water and 28 in. vacuum, per cent.	74	67	39	27.5
Vacuum in exhaust, 30 in. barometer, inches	28.03	28.18	28.28	27.34
Corresponding temperature, degrees fahr	101.0	97.8	95.9	109.4
Volumes exhaust steam times volume water of condensation	21 200	23 100	24 600	16 000
Steam condensed per square foot, pounds	5.62	5.1	2.85	3.07
Vacuum pump suction temperature, degrees fahr	56.7	58	58	56.2
Equivalent steam pressure, inches, abs	0.46	0.48	0.48	0.45
Air by volume in vacuum pump suction, per cent	76.5	73.7	72.2	83.4
Vacuum pump displacement times volume water of condensation	52.6	58.0	105.0	143.5
The same with 90 per cent volumetric efficiency assumed	47.3	52.2	94.5	129.1
Volume air reduced to temperature and pressure in exhaust pipe times volume water of condensation	30.6	40.7	73.3	118.0
Volumes air in exhaust steam per 10 000 volumes exhaust steam	18.7	17.6	29.8	73.7

TABLE II.—RESULTS SHOWING EFFECTS OF AIR MIXED WITH STEAM.

Test	Nest of tubes	Steam temperatures			Water temperatures			Difference temperatures inside and outside of tubes (†)	Steam condensed per sq. ft. per hr.	B.t.u. per hour per sq. ft.	B.t.u. per hr. per sq. ft. per deg. difference (†)	Air in steam by vol. per cent. (†)
		Entering (†)	Leaving (†)	Average (†)	Entering	Leaving	Average					
1	top	101.0	91.1	96.0	56.	66.	61.0	35.0	12.03	13020	372	6.
	middle	91.1	63.6	77.3	53.	56.	54.5	22.8	3.60	3888	171	51.
	bottom	63.6	55.3	59.4	52.	53.	52.5	6.9	1.30	1296	189	75.
2	top	97.8	91.7	94.8	56.	66.	61.0	33.8	10.89	11760	348	14.8
	middle	91.7	62.0	76.8	53.	56.	54.5	22.3	3.24	3498	156	47.
	bottom	62.0	58.0	59.0	52.	53.	52.5	6.5	1.08	1164	180	73.
3	top	96.0	89.3	92.6	54	60.	57.0	35.6	6.12	6609	186	14.
	middle	80.3	59.4	74.3	53.	54.	53.5	20.8	1.02	1101	54	47.
	bottom	59.4	55.6	57.5	51.6	53.	52.3	5.2	1.44	1554	30	72.
4	top	109.4	100.0	104.7	54.	57.5	55.7	49.0	2.64	2851	58	18.
	middle	100.0	62.0	81.0	54.	54.	54.0	27.0				38.
	bottom	62.0	54.4	58.2	52.	54.	53.0	5.2	1.50	1620	31	82

*A paper presented at the Detroit Meeting of The American Society of Mechanical Engineers.

†International Steam Pump Co., 724 Arch St., Philadelphia.

The exit volume of water passing through the air pump with this air was before condensation 11,000 times its volume. The proportion of air to 10,000 volumes of exhaust steam is therefore

$$\frac{4.37 \times 10{,}000}{11{,}000} = 4.0 \text{ volumes.}$$

This amount, 4.0 volumes of air per 10,000 volumes of steam, represents the upper limit of the proportion of air to exhaust steam anticipated by American practice in air pump guarantees; for the class of steam plant usually supplied with vertical twin air pumps, as indicated by the success of large numbers of these pumps in achieving their rated results.

Horizontal air pumps for 26-in. vacuum and 110° hot well temperature are rated by most manufacturers as having a displacement of about 20 times the volume of the water of condensation. This rating presumes the presence of air in the proportion of 6.3 volumes to 10,000 volumes of exhaust steam.

Air pumps for jet condensers for 70° injection and 26-in. vacuum, on the presumption that the discharge temperature will be 110°, are usually rated at a displacement of 52 times the volume of the water of condensation. On these presumptions, this displacement will be made up of

	Volumes.
Condensed steam	1.0
Air entering with steam through boiler	0.3
Condensing water	26.0
Air entering with condensing water	10.5
Air entering by leakage	14.2
Total	52,0

Figuring as above, 14.2 volumes of air in the air pump suction at 4 ins. absolute and 110° were before condensation 4.7 volumes per 10,000 volumes of exhaust steam, or to refer to the basis used before for the surface condenser, the air entering by leakage and in the boiler feed total 14.5 volumes and correspond to 4.8 volumes per 10,000 volumes of exhaust steam.

Here, then, are three different amounts, 4.0, 6.3, and 4.8 volumes air per 10,000 volumes of exhaust steam which the custom of air pump guarantees establishes as the limiting proportions of air to exhaust steam in usual practice in steam engine plants. The first of these values seems most reliable because of the high volumetric efficiency of the vertical twin air pump, but as this type of pump is most often used in steam plants which, from their nature are likely to have less leakage than the average plant, it is probable that 4.0 volumes is a little below the average. Neither of the other two values is likely to be as reliable as the first from the nature of the assumptions necessary in their deduction. It is therefore safe to say that a provision to handle about 4.5 volumes of air per 10,000 volumes of exhaust steam at 26 ins. is ample in steam-engine practice, and that more air than this indicates excessive leakage, this, however depending somewhat on the size and type of plant.

Of the air that must be removed from the surface condenser, part enters with the steam through the boiler from the feed water, the balance through leaks. If it be presumed that, as an outside figure, the feed water contains 1/20 of its volume of air at atmospheric conditions and is at 70° F., its relative volume, when it reaches the exhaust pipe entering the condenser, will be:

$$\frac{1}{20} \times \frac{459.5+125}{459.5+70} \times \frac{30}{4} \times \frac{10{,}000}{11{,}000} = 0.38$$

volumes per 10,000 volumes of exhaust steam; or if the feed be heated to 210° before being pumped into the boiler:

$$\frac{1}{20} \times \frac{459.5+125}{459.5+210} \times \frac{30}{4} \times \frac{10{,}000}{11{,}000} = 0.33$$

volumes per 10,000 volumes exhaust.

This shows that of the air pump capacity presumed necessary by manufacturers, about 7 to 9% is required to handle the air coming into the condenser with the feed water and that the balance is required to remove the air entering by leakage and is largely an unnecessary expenditure. Certainly, then, the responsibility for limiting the amount of air is with the prime mover and its piping, and it is only reasonable to expect those controlling these features of the plant to indicate the amount of air the air pump must handle and not to compel the condenser manufacturer to guess at it.

There seems to be no other means of measuring the air coming to any condenser than by the displacement of its air pump. The proportion of air mixed with the exhaust steam is so small that the temperature drop due to its presence could not be used. Thus, four volumes of air per 10,000 volumes of exhaust steam would cause a lowering of the temperature below that due to the pressure, of 0.014° F., at 28-in. vacuum and 0.015° at 26-in. vacuum.

Charts have been prepared to simplify the calculations necessary to determine the proportions of air and exhaust steam passing into the condenser, after the ratio of volume of water of condensation to volume of air passing through the air pump, and the temperature of this air, have been determined. The curves of the charts, Figs. 1 and 2, show the relations of these quantities. There are three sets of these curves in Fig. 1: for 4-in. absolute, 2-in absolute and 1-in. absolute respectively. Fig. 2 explains itself.

In Fig. 1, abscissæ are volumes of air added to 10,000 volumes of steam. Ordinates are ratios of the volumes of this air saturated at the temperatures marked on each curve to the volume of the water of condensation. Thus, the curve marked 26 ins. and 110° F. shows that an air pump displacement ratio of 12 volumes of air to 1 of water would, at this temperature and pressure, correspond to a mixture of 4.0 volumes of air and 10,000 volumes of steam at this same pressure, before condensation agreeing with previous calculation.

These curves are purely theoretical, and can be used for any type of condenser to determine the ratio after condensation of the volume of air and water at the temperatures corresponding to certain proportions of air mixed with the exhaust steam passing to the condenser and can therefore be used for selecting both dry air pump sizes and wet air pump sizes where hot-well temperatures are to be guaranteed and where the proportion of air to exhaust steam is either specified or assumed.

The curves also show the great influence of air pump suction temperature on the capacity of an air pump to handle air. Thus an air pump with 4-in. absolute pressure can handle about twice the amount of air at 90° it could handle at 110° and at 40° about three times its capacity at 110°.

This feature of the curves also shows quantitatively the benefit gained in reduction of volume of air by the "dry" system, using a rotative dry vacuum pump. Without sacrifice of hot well temperature, this system removes the air near or at the temperature of the injection. If used on the presumed conditions of the vertical twin pump first mentioned, 12 volumes of air at 4 in. absolute and 110° would be cooled to 70° and become

$$12 \times \frac{459.5+70}{459.5+110} \times \frac{1.42}{3.27} = 4.85 \text{ volumes.}$$

Referring to the curves it is seen that 12 volumes air and 1 volume water at 4-in. absolute and 110° and 4.85 volumes air and 1 volume water at 4-in. absolute and 70° were each 4.0 volumes of air and 10,000 volumes of steam (both at 26 ins. and 125°) before condensation.

The curves also show, although not accurately, the fallacy of the short rule so often used which presumes that halving the absolute pressure will double the volume of air to be handled. As a matter of fact, the volume will be increased much more than twice if there is no accompanying temperature change and at least twice unless there is a very considerable accompanying temperature reduction.

As an example: suppose a certain volume of air saturated at 70° F. (0.73-in. absolute) and 4-in. absolute, a usual condition in the suction pipe of a rotative dry vacuum pump when maintaining this vacuum. This air has a pressure of itself of 3.27 ins. absolute. If this volume be expanded to half the pressure and the air be still kept saturated at 70°, the air pressure itself will be 2 in. — 0.73 in. = 1.27 in. and its new volume will be $\frac{4-0.73}{2-0.73} = \frac{3.27}{1.27}$ or 2.57 times the original volume.

The actual conditions may be represented thus:

One vol. saturated air at 70° and 4 ins. absolute equal one vol. air at 70° and 3.27 in. absolute and one vol. steam at 70° and 0.73 in. absolute and becomes at 70° and 2 ins. absolute.

2.57 vols. saturated air at 70° and 2 ins. equals 2.57 vols. air at 70° and 1.27 ins. absolute and 2.57 vols. steam at 70° and 0.73 in. absolute.

If, however, in halving the pressure it is also cooled to 50° F. (0.36 in. absolute) the new volume will be

$$1 \times \frac{459.5+50}{459.5+70} \times \frac{4-0.73}{2-0.36} = 1.92 \text{ times original volume.}$$

Similarly, a certain amount of air saturated at 70° (0.73 in. absolute) and 28 ins. becomes at 70° and 29 ins.

$$\frac{2-0.73}{1-0.73} = 4.7 \text{ times original volume}$$

or at 50° (0.36 in. absolute) becomes

$$1 \times \frac{459.5+50}{459.5+70} \times \frac{2-0.73}{1-0.36} = 1.91 \text{ times original volume.}$$

All of these results are shown with fair accuracy (within 5%) on the curves, although the curves in the set for each particular vacuum were intended to be referred only to other curves in the same set and not to curves for any other vacuum.

If then, it be decided say, that 4.5 volumes of air per 10,000 volumes of exhaust steam shall be the permissible amount of air mixed with the exhaust steam in surface or jet condensers, and the purchaser's specifications be so drawn, the curves will show the volume of this air and consequently the effective vacuum pump capacity required for it for each vacuum and each air pump suction temperature. In the case of the jet condenser, due allowance must be made for the air carried in by the injection water, an amount that can be predicted with a fair degree of accuracy provided, of course, the water be taken from a quiet pool.

As an example of conditions often found, the results of four carefully conducted tests of a very large surface condenser on a steam turbine are shown in Table I. Tests No. 1 and 2 were made one a little above and one a little below nominal rating of the turbine and show from Table I that the air leakage in the turbine, piping and condenser based on ratio to volume of exhaust steam was about four times the largest amount customary in steam engine practice. Tests 3 and 4 not only show enormous leakage but also that the total amount of air increased as the load on the turbine decreased; a usual condition in steam turbines.

It is interesting to note the effect of the large proportion of air mixed with the steam, particularly in the bottom of the condenser, on the heat transferring capacity of the surface, as shown in Table II. Certain of the steam temperature readings of the test were liable to error through the impossibility of knowing surely that the thermometers were not influenced by water dripping on them from the colder tubes so all of these and the values derived from them are marked (?) However, as these readings are the average of readings taken in two different parts of the condenser in each case they cannot be far wrong.

It is very evident from these tests that the middle and bottom nests of tubes are doing practically no work and that the reason for this is the large proportion of air in the steam surrounding them as is shown approximately by the last column of Table II. The heating of the circulating water being largely prevented in all but the top nest of tubes, the efficiency of the circulating system is very low even at the larger loads; 14 out of a possible 46° in one case and 14 out of a possible 42° in another.

This analysis of the results of these tests reveals some features in the design of this condenser which might have been improved upon, but comment on these is irrelevant to the subject under discussion. It is, however, of interest to consider what must be done to improve the vacuum in this condenser. From the fact that the air pump suction temperature in these four tests was within 4.7, 6, 6.4 and 4.2°, respectively, of the injection temperature, it is inferred that the condenser is doing fairly well as an instrument for cooling, especially in view of the large proportion of air present. The fault can then be corrected only by decreasing the amount of air in the condenser either by taking care of the air leaks or by increasing the speed or size of the air pump.

To reduce the air in the condenser to the amount deduced for steam engine practice, the equivalent of 4.5 volumes in the exhaust pipe to 10,000 volumes of exhaust steam, would require that the air leaks shown in each of the four tests be reduced to 24.0, 25.5, 15.1 and 6.1%, respectively, of their present value, or that the speed or capacity of the air pump be increased about four times at full load on the turbine, about 6.5 times at half load and about 16 times at three-eighths load. The full benefit that would result from this change is hard to calculate, as it affects so many different features of the condenser. The first effect would be to reduce to one-quarter the proportion of air in the air pump suction pipe. As there is an ample amount of cooling effect, this change would not materially affect the air pump suction temperature. Taking Test 1 as an example, where the pressure of the steam alone in the air pump suction pipe (Table I., line 8) was 0.46-in. and the air pressure therefore 1.97 — 0.46 = 1.51 ins.; a reduction of the latter to one-quarter would result in a pressure of 0.46 + 0.38 = 0.84-in. absolute, plus an allowance for the falling off in the efficiency of the vacuum pump at the higher vacuum. Practically, at least, 0.9-in. absolute might have been expected.

The curves also show that with 70° injection temperature, presuming that the air pump suction temperature could not be more than 75°, the vacuum with same load and same air leakage as Test 1 would be 2.5 ins. and with the leakage usual with steam engines would be equal to 1.3 ins.

This excessive leakage was, therefore, causing a winter vacuum of 28.03 that ought to have been at least 29.1 ins. and was likely to cause a summer vacuum of only 27.5 ins. where it should have been at least 28.7 ins. The winter loss of fuel, due to the excessive leakage of this unit, averaged probably half a ton per hour. In spite of this enormous loss and in spite of the fact that it was known that the vacuum was not what it should have been, no attempt was made to analyze the results obtained on a scientific basis to locate the cause of the trouble; in fact, the engineers concluded that the air pump was too large, whereas it was entirely too small for the air leaks present.

It is to be regretted that there is not more information available on which exact estimates of air leakage can be made. There are turbine plants comparable in size with the plant cited above, in which the air leakage is less than we have assumed as the maximum allowable amount in steam engine practice.

It must also be evident that comparisons of results obtained in different plants and from different types of con-

densers cannot possibly be trustworthy unless the proportion of air for each case has been determined and due allowance made therefor. The amount of air present exerts a great influence on (a) the relation between temperature and vacuum in the condenser; (b) on the air removing capacity of the air pump; and (c) on the heat-transferring capacity of the surface or spray. The plant so fortunate as to have the smallest air leakage might have an advantage sufficient to wipe out entirely the benefits that might be gained by any refinements in the design of a condenser under comparison. Thus, a comparison between the condenser referred to in Tables I and II., which was provided with a cooler, and a unit which had its cooler removed, shows results apparently favoring the latter. The methods of measuring and comparing air leakages suggested in this paper would not only show this to be an erroneous conclusion and that air cooling was of great benefit to the unit, but it would also show the amount to be gained by such cooling.

The suggested measurement of the air coming to condensers necessitates the following readings:

1. Pressure in air pump suction.
2. Temperature of air pump suction.
3. Quantity of steam being condensed.
4. Effective vacuum pump displacement.

For ordinary work and with properly built condensers, the vacuum in the condenser could be taken for the first reading, but for exact work the pressure and temperature should both be taken at the same point in the suction pipe. The third quantity is generally well known. The fourth quantity requires readings of the speed of the vacuum pump and an estimate of its volumetric efficiency from its indicator card.

For barometric condensers and jet condensers with air pumps, certain allowances have to be made, requiring for their determination some previous practice with condensers of other types.

As the data necessary for the estimation of air in condensers is so easily obtained, it is hoped that this paper will eventually result in the application of the same scientific methods to air leakage in condensers that are now applied to all the other features of the power-house. A full appreciation of the effect of air in condensers on coal consumption and an exact knowledge of the amount and probable source of this air should result in generally higher vacuums and an increase both in the efficiency and capacity of the plant. The methods suggested in this paper can be used in the analysis of existing condenser plants to see how their results can be improved, assisting in determining whether the cooling features or the air removing features are limiting the vacuum and if the latter, determining just what improvements could be made and how much.

It is hoped that engineers in testing condensers will make it a point to estimate the air present and publish their results to the end that more may be known of the possibilities of reducing air leakage, and the maximum amount allowable in good practice established, that eventually air in condensers may cease to be the subject of guesswork.

BRIGADIER-GENERAL WILLIAM L. MARSHALL, CHIEF OF ENGINEERS, U. S. A.

The vacancy in the office of Chief of Engineers, which has existed since the retirement of Gen. Alexander Mackenzie on May 25, has been filled by the appointment of Gen. William L. Marshall, who for the past eight years has had charge of the U. S. Engineer Office at New York City. General Marshall was born in Kentucky in 1846 and began his military career as a private soldier. When the Confederate General Bragg invaded Kentucky in the summer of 1862 Marshall, then a boy of only 16, enlisted in the Tenth Regiment of Kentucky Volunteer Cavalry and served for 13 months as a private soldier. While in the army he received an appointment to the West Point Military Academy and was discharged from the army to go there. He graduated in June, 1868, ranking seventh in a class of 54 members.

He was commissioned Second Lieutenant in the Corps of Engineers and served for two years with the Engineer Battalion and at the Engineer School at Willet's Point, N. Y. He was then a year at West Point as Assistant Professor of Natural and Experimental Philosophy. In 1872 he was sent to the far West with the exploring party under Lieutenant Wheeler, and the next four years were given to arduous work in the surveys and explorations west of the 100th meridian. During this time Lieutenant Marshall was in command of from four to eleven parties, constituting the Colorado section of the survey. The work was carried on, however, in Colorado, Utah, Nevada, Arizona and New Mexico. Lieutenant Marshall had charge of the reduction of the astronomical and hypsometrical work and of part of the geodetic computations. It was while on this survey that Lieutenant Marshall discovered, mapped and profiled the pass across the Rocky Mountain divide which has since been named "Marshall Pass." He also discovered the gold placer deposits in the Marshall Basin at the head of the San Miguel River and the coal deposits in the Elk Mountains in Colorado. In connection with the geodetic work, he made ascents of and established triangulation stations upon some 97 mountain peaks of over 12,000 ft. altitude; a number of these exceeded 14,000 ft. in altitude.

In 1876 he was transferred to Tennessee, under Captain King, and was engaged as an assistant engineer on the construction of the Muscle Shoals Canal and the building of three locks and dams on the Coosa River in Alabama. In 1881 he was transferred to the Mississippi Valley improvement work under orders of the Mississippi River Commission, and built some 36 levees in Louisiana, Mississippi and Arkansas. About 4,500,000 cu. yds. of earthwork were built under his direction, partially by hired labor without the letting of contracts. He was also engaged in the work of channel improvement at Vicksburg Harbor and Lake Providence Reach, La. All the work on the channel and the bank revetment was done by hired labor under his own personal supervision.

He received his Captain's commission June 15, 1882, and was shortly thereafter transferred to harbor improvement work in Southeastern Wisconsin and the improvement of the Fox and Wisconsin rivers. Several harbors on Lake Michigan north of Chicago were under his charge. A large part of the work on the regulation of the level of Lake Winnebago and the locks and dams on the Fox River was carried on by Captain Marshall with hired labor and without letting contracts.

For the next twelve years, Captain Marshall's work was in the vicinity of Chicago, where the Chicago and Calumet harbors were under his charge, and also the construction of the famous Hennepin Canal with the Illinois River improvements in connection therewith. The right-of-way for the Hennepin Canal was surveyed and title acquired by Captain Marshall, involving a distance of about 107 miles, about 400 different pieces of land, and over 2,000 different parties interested in the legal proceedings. Captain Marshall designed all the works for the canal, and constructed 24 locks, many bridges, culverts and aqueducts, and between one-half and two-thirds of the trunk of the canal, in great part by hired labor. The dams at La Grange and Kampsville, in connection with the locks at those points, were of special construction and were designed by him.

During this time, also, Colonel Marshall served on many important boards. He was made a member of the Missouri River Commission Nov. 6, 1897, and during the World's Columbian Exposition was in charge of the Engineer Section of the War Department Exhibit. A mere list of the different boards on which he has served would require no small amount of space, but it may be mentioned that he was the president of a special commission of experts on the water supply of the city of Washington in 1895, and that he was a member of the board of engineers which reported on the Cascade Locks of the Columbia River in 1894, of the board which reported on canals from Lake Erie to the Ohio River in Ohio in 1895-7, and on the surveys for a waterway from Lake Michigan to the Illinois River at La Salle in 1899. During his connection with the Hennepin Canal work and the Illinois River improvement, Colonel Marshall invented several types of automatic movable dams for river improvement.

Colonel Marshall was transferred to the U. S. Engineer Office at New York City in 1900, and his most important work here probably has been the dredging of the great Ambrose Channel, by which a straight passageway will be furnished, 40 ft. in depth, from New York Harbor to deep water in the ocean. Some 31,000,000 cu. yds. have already been dredged from this channel, and it is now of sufficient depth and w[illegible] for the largest vessels afloat to pass through [illegible] any phase of the tide above mean low water. [illegible] the work was originally let by contrac[illegible] t 9 cts. a cu. yd., the contractor failed a[illegible] the work has since been done by hired lab[illegible] and dredges built by the United States, at [illegible] cost less than the contract price, as fully r[illegible]ted in this journal a year or more ago. Oth[illegible] im-portant work in the district in charge of [illegible]onel Marshall has been the enlargement of Gov[illegible]or's Island from 65 to 102 acres, and dredgi[illegible] the Buttermilk, Bay Ridge and Red Hook [illegible]an-ne's, involving the removal of some 22,[illegible]000 cu. yds. of material. The fortification wo[illegible] at the eastern and southern entrances to New [illegible]ork Harbor have also been under Colonel Mar[illegible]ll's charge, and works have been built at [illegible]orts Slocum, Totten, Schuyler, Hamilton, Wads[illegible]rth and Hancock. He has completed and t[illegible]ned over to the Artillery Department about 9[illegible]em-placements for modern guns and mortars [illegible]and no less than 230 other structures in conne[illegible]ion with the forts.

During these eight years, also, Colonel [illegible]ar-shall has served upon many boards of eng[illegible]eer officers. We may take space here to men[illegible]tion one of these, of special historical interes[illegible] to wit, he is secretary and disbursing officer o[illegible] the Prison Ship Martyrs Monument Commis[illegible]on, which has in charge the erection of a monu[illegible]ent in Fort Greene Park, Brooklyn, to the memory of the Revolutionary soldiers and sailors who died on the British prison ships.

General Marshall will have to years to serve in the office of Chief of Engineers, as his retirement for age will take effect on June 11, 1910. It may be added that his promotion to the highest office in the corps came to him entirely without solicitation or desire on his part, as his preference was to remain in the New York office and complete the work on the Ambrose Channel, which has enlisted his strongest interest.

COMPETITIVE TESTS OF CAR FENDERS AND WHEEL GUARDS.

The Public Service Commission of New York City has announced that a series of tests of street car fenders and wheel guards will be held under its direction next fall. One series of tests will be made at the General Electric Works at Schenectady early in September and another at the Westinghouse Works at Pittsburg a month later. From the commission's announcement of the tests we quote as follows:

Manufacturers and inventors of fenders and wheel guards from every state in the Union, as well as from England and European countries, will be invited to participate in these tests and to present their inventions for practical demonstration.

The purpose of the tests is to enable the Commission to decide by a public competition in a fair, practical trial what types of fenders and wheel guards are best adapted for use in this city to the end that the devices, which most commend themselves, may be recommended for installation by the operating companies here.

The decision to hold these tests is the outcome of the first year's experience of the Public Service Commission. Organized on the first of July, 1907, the Commission had not been in office three months until the humanity of its members was shocked by the terrible mortality due to accidents on the street railroads. Under the Public Service Commission's Law, it is the duty of street railroad companies to report to the Commission at once every accident occurring on their lines resulting in loss of life, serious injury to persons, or great damage to property. For the first time, it was possible for a public agency to collect the statistics of such accidents and focus the results in a series of monthly tabulations.

As soon as an accident is reported, if it is serious enough to warrant investigation, the Commission sends one of its inspectors to the scene. That inspector makes a careful investigation and reports to the Commission. From these reports, the results for each month are tabulated and published.

It was found, much to the surprise and horror of the Commissioners, that the street railroads of Greater New York were killing men and women at the rate of forty or fifty a month, and for the last six months of 1907, the number killed in this way aggregated 288, an average of 48 a month. To end such havoc with life and limb became the Commission's immediate task. It had general investigations made of operating conditions on all

lines of street railroads and appointed a special committee on safety devices to receive and consider suggestions, inventions, and existing devices for the prevention of accidents. This Committee consists of A. W. McLine, Electrical Engineer of the Commission, Daniel L. Turner, Chief Engineer of the Transit Inspection Bureau, and George F. Daggett, Chief of the Accident Bureau. In its first report to the Legislature, dated December 31, 1907, the Commission pointed out the appalling results of street car accidents and announced its intention of doing everything to minimize the evil.

Since its appointment last fall, the Committee on Safety Devices has had meetings every week and has received innumerable suggestions for the prevention of fatal accidents. Inventors who have solved the problem only by their own brains, those who have gone a step further and protected their ideas by patenting, as well as proprietors of marketable inventions, which are already manufactured, and in general or restricted use, all flocked to the Committee to have their devices tried.

As it became apparent from the reports of accidents that a large number was due to defective or imperfect fenders or wheel guards, so the inventive talent of the country sensed the critical point and by far the larger number of inventions submitted to the Committee related to fenders and wheel guards. All these have been carefully examined and so far as possible, given model tests in the offices of the Commission, but the Committee soon determined that, in order to reach a just conclusion and to properly gage the merits of competing inventions, it would be necessary to hold public tests in a practical way. Its recommendation that the Commission provide for such tests was favorably considered and after months of consideration, the forthcoming competitions at Schenectady and Pittsburg were arranged for.

That the Commission should go so far from New York City to hold tests of appliances to be used within New York City, may seem strange at first glance, but the reasons are plain and cogent. To make the tests absolutely impartial, it is necessary to hold them at some point where no street railroad company or no manufacturing company interested in a special device can exert any influence upon the progress or result of the test. In a sense, too, the proposed tests are of national importance, for the reason that maufacturers of fenders and wheel guards are widely scattered throughout the country and the public authorities of other states and cities, who have their own troubles with the fender and wheel guard problem, are looking to see what the New York Commission does before taking action in their local fields.

It was found by personal investigation that the General Electric Works at Schenectady, and the Westinghouse Works at Pittsburg, not only afford every facility in the way of tracks, trolley wires, cars, motormen, etc., for such tests, but that neither the General Electric Co. nor the Westinghouse Co. has any interest whatever in any device which will enter into the competition. Hence they offered the best locale in the country, in the estimation of the Commission's engineers, to insure the impartiality of the test.

Both companies offered the Commission every facility for carrying on the competitions. Each will provide a stretch of track properly electrified and cars and motormen to run over it. Care will be taken also to reproduce as far as practicable the actual conditions of street pavements, grades, etc., existing in New York. While the Commission realizes that perhaps the true test of a fender is its merit as a life saver, consideration will also be given to its ability to withstand the rough usage of every day operating conditions without excessive maintenance. The latter quality probably cannot be proved in the proposed test, but due weight will be given to it in the final determination of the merits of any device.

To test the qualities of a fender, dummies will be used to represent persons. These will be placed on the tracks and will be run into by the cars with fenders attached at speeds varying from eight to twenty miles an hour. There will be three dummies, the largest one weighing 170 lbs., to represent a full sized man; another weighing 120 lbs., to represent a youth, and the smallest weighing 50 lbs., to represent a child. Ten different tests with each dummy will be called for, including an upright posture facing the car and away from it; an upright posture with the side of the body toward the car; the position of lying on the track in various attitudes, and lying along the rail with head and arms in dangerous positions.

It is expected that the test at Schenectady will take about ten days, and that at Pittsburg some shorter time, as there are fewer manufacturers in the West than in the East. Preliminary work to put the testing grounds in proper shape is already under way under the supervision of the Commission's engineers, and when the time comes, it is expected that members of both Public Service Commissions of this state, as well as those of similar organizations in other states, not to speak of numbers of prominent railroad men and the railroad engineers from various parts of the country, will be present.

Some of the readers of Engineering News may recall the series of tests of car fenders made by the Massachusetts Railroad Commission seventeen years ago, in the very early days of electric street railways, and reported in Engineering News, Vol. Jan.-June, '91, p. 170, and Vol. July-Dec., '92, p. 402. The roport of a commission on car fenders for use in Baltimore was also published in Vol. July-Dec., 1894, p. 258. Reference to the "General Index" to Engineering News for the years 1890-1899, shows a long list of articles on car fenders published during that period. In more recent years, however, there has been comparatively little interest taken in car fenders. Those now taking up the subject will do well particularly to refer to the report of the Massachusetts Railway Commission, mentioned above, it contains the most complete statement regarding the principles of fender design that has anywhere appeared.

We may note that one of the chief difficulties found in the tests seventeen years ago was the pitching of the car body fore and aft and consequent variation in height of the fender from the track. This difficulty, experienced with the short four-wheel cars of that day, should be practically eliminated with the long eight-wheel cars now in general use. To this extent, therefore, the fender problem should be much easier of satisfactory solution.

COEFFICIENTS OF DISCHARGE THROUGH CIRCULAR ORIFICES.

In our issue of Sept. 27, 1906, we published a paper by Mr. Horace Judd and Prof. Roy S. King, describing experiments made at Ohio State University to determine the discharge from circular orifices.

A notable series of experiments in the same field has recently been carried out at Melbourne, Australia, by Mr. H. J. I. Bilton, Assoc. M. Inst. C. E., Assistant Engineer of the Victorian Railways. A paper describing these experiments was read by Mr. Bilton before the Victorian Institute of Engineers on April 1. Copies of the complete paper can probably be obtained by addressing Mr. Bilton. Space permits us to present only the following extracts, which include, however, the conclusions reached by Mr. Bilton as a result of his experiments, which appear to have been made with great care and to be reliable:

The discharge of circular orifices has been, perhaps, one of the most closely investigated subjects in hydraulics, numerous tests having been made by experimenters all the world over. Nevertheless the information at present available, although sufficiently approximate for ordinary practical requirements, is contradictory and uncertain in its details.

It is known that the coefficient of velocity at the contracted vein is unity within a small fraction of 1%, i. e, the velocity is as nearly as possible equal to the theoretical velocity $\sqrt{2gh}$. The coefficient of contraction is usually given as about 0.62, i. e., the area of the contracted vein is approximately ⅝ of the area of the orifice, varying as the coefficient of discharge.* The coefficient of discharge is usually given by the text books as 0.62 (the mean of a large number of experiments), but in reality it varies considerably, according to the head of water and diameter of orifice. In addition to decreasing as the diameter increases, under low heads it decreases rapidly as the head increases. For heads of about 5 ft. and over it has hitherto been assumed (principally on the basis of experiments made and collected by Hamilton Smith, Jr.) that it also decreases as the head increases, but in less degree, up to a head of 100 ft., under which head it is given as .592* for all diameters from ½ in. to 12 ins. Probably amongst the latest experiments are those made by Messrs. Judd and King at the Ohio State University, U. S. A., described in "Engineering News" of Sept. 27th, 1906.

These experiments were carried out on orifices of the following diameters: ¾-in., 1-in., 1½-in., 2-in. and 2½-in., under heads varying from 4 ft. to 93 ft. "The results did not show any great change in the coefficient of discharge for an increase of head." The following results of tests on the 2-in. orifice will suffice as an example:

Head in feet.	Coeff.
5.00	.6084
9.06	.6083
17.79	.6080
23.24	.6083
36.12	.6082
47.02	.6088
57.70	.6081
69.99	.6080
92.01	.6080

*Conclusions of Hamilton Smith, Jr., tabulated in "Merriman's Hydraulics," p. 79.

Considering that the average coefficient for the above orifice is 0.6083, in other words, that the actual discharge averaged 60.83% of the theoretical, with such small variations, the question naturally arises as to whether the theories hitherto accepted are correct.

As bearing on the subject it may be mentioned that a large number of experiments were recently made by the writer on small re-entrant pipe mouthpieces, 2½ diameters in length, in which he found that the coefficient of discharge clearly decreased as the diameter increased up to a certain diameter, but he could find no difference due to variations in head down to as low a head as 6 ins., or to changes in temperature within a range of from 65° to 100° F. The coefficient of discharge usually given for this type of pipe outlet or mouthpiece is 0.71. The average results obtained by the writer for various sized outlets are as follows:

Diam.	Coeff.
⅛-in.	.91
¼-in.	.87
⅜-in.	.85
½-in.	.83
¾-in.	.81
1 -in.	.79
1½-in.	.77
2 -in.	.76
2½-in.	.75

Experiments on circular orifices do not appear to have been systematically carried out on diameters of less than ¼-in., and it occurred to the writer that if experiments were made on a series of orifices of small diameter, commencing at very low heads, some further light might be thrown on the subject.

The text books are usually careful to state that the coefficients given are for standard vertical orifices, i. e., orifices in a thin vertical plate, sometimes called frictionless orifices. The coefficient of discharge for orifices on a horizontal plane and at the intermediate angles between the vertical and horizontal do not appear to have been investigated, so that some experiments in these directions were warranted.

The orifices used in the writer's experiments were of the following diameters: 0.025 (1/40-in.), 0.05 (1/20-in.), 0.1, 0.15, 0.2, 0.25, 0.30, 0.4, 0.5, 0.6 and 0.75 inches. The orifice plates were of brass, 1/16-in. to ⅛-in. thick. The diameter of each plate was at least seven times the diameter of the orifice, and for the six smallest was 2 ins. A brass gage was made for each orifice except the ¼-in., ½-in. and ¾-in., for which standard steel gages were used.

The brass gages were made to exactly the diameter required, several being made for each of the smallest orifices and the most accurate selected. For measuring their diameters a 1/10000-in. Starrett spring touch micrometer was used. The orifices were first made slightly smaller than the gages, then countersunk to as nearly as possible a feather edge, and finally rimered out until the gage could only be forced through the orifice by being held exactly at right angles and twisted through with considerable exertion. It is thought that the diameter of the larger orifices would not vary more than 1/4000 in., and of the small ones more than 1/10000 in. from the true diameter. It is computed that an error of 1/4000 in. in the diameter of the 0.75-in. orifice would have a negligible effect on the coefficients of discharge; that a similar error in the ¼-in. orifice would affect the coefficients about one unit in the third decimal place; that an error of 1/10000 in. in the 1/10-in. orifice would affect the coefficients to the extent of two units, and in the 1/40-in. orifice to the extent of six units in the third decimal place.

The three smallest orifices were originally made similar to the others, in brass plates countersunk. The results obtained were so erratic as to almost lead to the abandonment of the experiments. Careful observation, however, showed that capillary attraction caused a globule of water to form in the countersunk portion immediately under the jet, suppressing contraction and increasing the discharge by 10 to 15%. These plates were consequently abandoned and new orifices made in specially rolled sheet brass 0.005 in. thick, about ⅛-in. diam. These were spun flush into the back of 1/16-in. plates, 2 ins. in diameter, having holes in the center about three times the diameter of the orifice proper. To the writer's surprise, the results obtained from these minute orifices, especially the 1/10 in., were as consistent and satisfactory as those of any of the larger ones.

The writer's conclusions may be shortly expressed as follows:

1. The assumption that a coefficient of discharge common to all orifices from ½-in. to 12-in. diameter is reached at a head of 100 ft. is erroneous.

2. That in order to obtain complete and perfect contraction, a certain minimum diameter and head are required. These appear to be approximately 2½ ins. and 17 ins., respectively.

3. That orifices of 2½ ins. diameter and over, under heads of 17 ins. and over, have a common coefficient of discharge, lying between 0.59 and 0.60, but which is probably about 0.598 (subject to the head being not less than 2 or 3 diameters).

4. That in the case of orifices smaller than 2½ ins. diameter, contraction is never perfect and complete under any head, but is suppressed more and more as the diam-

eter decreases, each size of orifice having its own constant or "normal" coefficient of discharge and its own critical head.

5. That as the diameter decreases, the normal coefficient increases, as also the critical head.

6. That in an infinitely small orifice, contraction is entirely suppressed and unity becomes the coefficient of discharge for all heads (subject to the effects of capillarity, cohesion, viscosity, temperature, etc.).

7. That the discharge of a circular orifice under any given head is the same, whether the jet be horizontal, vertical, or at any intermediate angle.

NOTES FROM ENGINEERING SCHOOLS.

DICKINSON COLLEGE, CARLISLE, PA.—The degree of Doctor of Laws has been conferred on Mr. Alexander C. Chenoweth, of Brooklyn, by the faculty of Dickinson College.

MICHIGAN AGRICULTURAL COLLEGE.—The new engineering building was dedicated June 22. An address on engineering education was delivered by Prof. Rolla C. Carpenter, of Cornell, one of the alumni of Michigan Agricultural College.

CORNELL UNIVERSITY.—Mr. David A. Molitor, M. Am. Soc. C. E., a former government engineer who is now working on designs for the great locks of the Panama Canal, has been appointed Professor of Topographic and Geodetic Engineering at Cornell. H. N. Ogden, Assoc. Am. Soc. C. E., and V. Karapetoff, who have hitherto acted as assistant professors, have been promoted to professorships of sanitary engineering and electrical engineering, respectively.

A TORNADO struck Fort Summers, N. Mex., July 2, killing 5 persons and injuring about 40 more. Many more were rendered homeless.

IN A GAS EXPLOSION AT THE RIKOVSKEY MINE, near Yusovo, European Russia, July 2, 300 men are reported dead; 214 bodies have already been recovered. A fire has broken out and is working toward the inner galleries where it is said that 150 men are still alive but imprisoned, and in spite of their audible cries for help, cannot be reached by rescuers.

THE ENGINEERS OF THE RAND, South Africa, have taken an important step in the development of technical practice and broad minded professional ethics. It has hitherto been the custom for the various companies operating in this most progressive district to carry on their experiments toward the betterment of their mining and milling systems independently of one another. As a result frequent duplication of work ensued, causing unnecessary and disheartening loss of time and money. To obviate such occurrences, and to promote the unification of effort in solving the engineering problems before the community. A "Metallurgical Trials Committee" has been organized to supervise and encourage future work of any nature which aims to improve the general status of the industry.

A NUMBER OF SERIOUS RAILWAY ACCIDENTS occurred during the week: On July 2 the Missouri Pacific Railway's "California Limited" collided, head-on, with the east-bound St. Joseph Express at Knobnoster, a flag-station 20 miles east of Sedalia, Mo. Seven persons are reported killed and 20 injured. The disaster was due, it is said, to the failure of the engineer of the Limited to observe the signals which had been set for him at Knobnoster ordering him to take the siding at that place. At Oakland, Cal., 6 men were killed and 30 injured in a grade crossing collision on a narrow-gage railway; a local train bound from the Alameda Mole to Oakland, running at 40 miles an hour, struck the smoking car of a barely moving Santa Cruz train on a crossing, cutting it out from between a Pullman and a baggage car and knocking it to slinters. A mile and a half east of Boonville, N. Y., a north-bound passenger train on the Rome, Watertown & Ogdensburg R. R. early on the morning of July 4 met a freight train when both were running at high speed. So close were the trains when they sighted each other, that the engineers had time only to throw off the power and put on the brakes. Four men were killed and 9 injured.

AN INLAND WATERWAY IN MEXICO, between Tuxpan and Tampico on the Gulf of Mexico, is now about half completed and in use. These two towns are about 104 miles apart and are both important ports in the gulf coasting trade, but the presence of bars in the harbors and the occasional high winds have prevented the free passage of boats between the two. The new canal is being built from two to four miles inland, making use for most of the distance of the lagoons which run up from the gulf. It is 75 ft. wide and 10½ ft. deep and will cost when finished about $2,500,000 gold. In addition to its services as a means of connection between its termini, the canal is expected to open up a fine agricultural country which is at present deficient in transportation facilities.

SHIPBUILDING IN THE UNITED STATES during the fiscal year ending June 30, 1908, showed a considerable increase over previous records. The following report has just been given out by the U. S. Bureau of Navigation:

During the year 1,506 vessels, of 588,627 gross tons, were built and numbered in the United States, of which 75 steel steamers, of 304,379 gross tons, were built on the Great Lakes.

The largest annual output heretofore was in 1855, when 2,024 vessels, of 583,450 tons, were built. In that year the Great Lakes built only 263 vessels, of 45,453 tons. This year steel vessels built numbered 142, of 417,167 gross tons, compared with 390,665 tons built last year. These two are the years of the largest steel construction in the United States.

The tonnage is entirely for domestic transportation, no vessels exclusively for foreign trade having been built in the United States. Of the 142 steel vessels 85 exceeded 1,000 gross tons each, 55 on the Great Lakes, the largest being the "William M. Mills," of 7,962 tons, and 30 on the seaboard, the largest being the "Columbian," of 8,579 tons, built at San Francisco for trade to Hawaii.

Four wooden sailing vessels exceeding 1,000 tons each were built during the year.

LEVEES ON THE LOWER MISSISSIPPI BROKE June 16, at Lucas, eleven miles below Shreveport, La., letting the water run over all the Bayou Pierre plantations. On June 18 the Prairie du Pont Levee, near Cahokia, Ill., the Chouteau cross levee between Mitchell and Granite City, and the Wageman levee in St. Charles Co., opposite Alton, Ill., gave way, inundating 10,000 acres of wheat land. On June 21 the river reached a height of 34.1 ft. at Cape Girardeau, Mo. A crevasse in a levee at the upper boundary of the Beka plantation near New Orleans, La., was successfully repaired, June 16, by the construction of a mud box 45 ft. square. On June 19 the river from Alton to St. Louis, having reached a maximum height of 34.8 ft., began to recede. Buildings at Nos. 216-18 North Commercial St., St. Louis, had been so weakened at their foundations that they fell over the elevated terminal tracks into the water. No persons were in them at the time. Heavy loss is entailed by these levee breaks, which are the result of the heavy floods of the week before.

THE PENNSYLVANIA R. R. HUDSON RIVER TUNnels are not to have pile foundations as were originally contemplated, according to a recent statement of Vice-President Samuel Rea, who is in general charge of the New York extension work. Apparently this decision is based partly on the stability shown by the continuous survey records since the completion of the tunnels, and partly on the successful operation of rapid-transit trains through the two tunnels of the Hudson Companies two miles farther south.

THE DEER LODGE NATIONAL FOREST RESERVE is the chief source of timber supply for the copper mines of Butte. Arrangements have just been made for the sale of the timber on about 8,000 acres for which the Government will receive some $250,000.

The timber is almost wholly lodgepole pine—a tree of small size, at best, but large enough to supply stulls, lagging and converter poles. The trees form a dense forest of nearly even sized trees. This renders it impossible to take out only the larger trees, and the government foresters are allowing the cutting of narrow strips clean, while from the intervening strips of timber left standing only the dead and diseased trees are taken. After a strip is cleared, it will be seeded up with young trees from the strips of timber left standing on either side, and only when this has been completed, probably ten or twenty years from now, will the remaining timber be cut. When it is cut, the trees then growing on the strips which are now cut clean, will seed up the newly cut areas, and the whole forest will be started afresh.

In this forest, as in every other, the greatest danger to the program planned by the foresters is fire, but in the present cutting every precaution is taken to lessen this risk. The brush from the tops of the trees is being piled, and later, when the ground is wet or covered with snow, the piles will be burned under the direction of a forest officer. Complete disposal of the brush leaves nothing on which a forest fire may gain headway, and, safe from this greatest danger, the forest is left to supply wood for the future and to regulate the flow of the streams which drain it, and meanwhile, the great mining industry of Butte is securing the timber it must have if it is to continue.

PERSONALS.

Mr. J. L. Darnall has been appointed City Engineer of Kansas City, Mo., to succeed Mr. E. A. Harper, M. Am. Soc. C. E., resigned.

Mr. C. J. Hogue, Assoc. M. Am. Soc. C. E., Principal Assistant Engineer, Philippine Ry., has resigned. Mr. Hogue sailed for the United States from Hon[illegible] on July 3.

Mr. C. G. Frosel, M. Am. Soc. C. E., recently [illegible]neer at the Pencoyd plant of the American Bridge [illegible] has resigned. Mr. F. L. Castleman has been app[illegible]d to the vacancy.

Mr. G B. Ashcroft, C. E., formerly Superint[illegible] of the Roman Stone Co, Toronto, Can., has been [illegible]nited Manager of the Cement Production Co., with offi[illegible]ms Balboa Bldg., San Francisco, Cal.

Mr. C. G. Wrentmore, Assoc. M. Am. Soc. C. E[illegible]nior Professor of Civil Engineering at the Unive[illegible]y of Michigan, has been appointed Assistant Dire[illegible]r of Public Works in the Philippine Islands, with h[illegible]uar-ters at Manila.

Mr. Thomas C. J. Baily, Jr., M. Am. Soc. C. [illegible] formerly Assistant Engineer of Bridges, District of [illegible]olum-bia, has been appointed Assistant Engineer, Sew[illegible] Department, District of Columbia, vice Mr. Asa E. P[illegible]ips, M. Am. Soc. C. E., who recently assumed the d[illegible]es of superintendent of the department.

Capt. Albert F. Dickson, Assistant Chief of the [illegible]reau of Steam Engineering, U. S. N., has been appointed Chief Inspector of Machinery, with headquarters in New York City, succeeding Rear-Admiral J. A. B. Smith, retired. Commander R. S. Griffin, now in the bureau, will become Assistant Chief, succeeding Capt. Dickson.

Mr. A. B. Jones, Engineer of Maintenance of Way on the Cleveland, Akron & Columbus Ry. has resigned to become identified with a rubber enterprise in Akron, Ohio. His successor is Mr. R. C. Harris. Mr. Guy Scott is advanced to engineer of maintenance of way on the Toledo division of the same road, to succeed Mr. Harris. Mr. F. N. Crowell is advanced to engineer of maintenance of way on the Richmond division to succeed Mr. Scott, and Mr. Scott is succeeded on the Marietta division by Mr. S. W. Hodgin.

Obituary.

George H. Daniels, formerly General Passenger Agent of the New York Central & Hudson River R. R., died at his summer home, at Lake Placid, N. Y., on July 1. He was born in Hampshire, Ill., Dec. 1, 1842, and started his railroad career as rodman in the engineering corps of the Northern Missouri R. R. He had been General Passenger and Freight Agent of the Chicago & Pacific R. R., of the Wabash, St. Louis & Pacific R. R. and of the New York Central. He retired from his position with the last-named road on May 1, 1907.

ENGINEERING SOCIETIES.

COMING MEETINGS.

AMERICAN SOCIETY OF HEATING AND VENTILATING ENGINEERS.
July 24-25. Summer meeting at Niagara Falls, N. Y.
Secy., W. M. Mackay, P. O. Box 1818, New York City.

OHIO ELECTRIC LIGHT ASSOCIATION.—The fourteenth annual convention will be held Aug. 25-27, at Put-in-Bay Island, Ohio. The topics to be presented at this meeting, in the form of papers, will be substantially as follows: "Should Central Stations do Wiring?" "Why Municipal Ownership of Lighting Stations Has Not Been a Success"; "How Can We Best Increase Our Business"? "Experience With Luminous Arc Lamps"; "Electric Signs and Other Special Uses of Electricity as an Adjunct to Profitable Station Work"; Gas and Gasoline Competition and Best Ways to Meet It"; "Lecture on Illuminating Engineering"; Best Ways and Means of Keeping Out and Getting Out Private Plants in Central Station Territory"; "The Gas Engine in Central Station Work"; "Gas Producing Plants and Oil Engines and Their Results"; "Report Upon the Experience of a large number of Central Station Men on the Tungsten Lamp."

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—The inaugural meeting was held at the Engineers' Club, Philadelphia, on June 22. Dr. C. F. McKenna delivered an address on the recognition of the place of the chemical engineer with that accorded the mechanical or civil. The committee on a constitution brought in a draft of a proposed form defining the purposes of the institute, qualifications for membership, etc. The proposed constitution was adopted by which the yearly dues were fixed at $15, with no initiation fee. The qualification for membership are an age of 30 years and ten years practical experience. There is a reduction in the 10-year period for degrees received.

The following officers were elected: President, S. P. Sadtler, Philadelphia; First Vice-President, C. F. McKenna, New York; Second Vice-President, A. Hunicke, St. Louis; Third Vice-President, E. G. Acheson, Niagara Falls; Treasurer, W. M. Booth, Syracuse; Secretary, J. C. Olsen, Brooklyn; Auditor, R. K. Meade, Nazareth, Pa.; Directors for one year, Ludwig Reuter, Berkeley, Cal.; Thorn Smith, Isabella, Tenn.; H. F. Brown, Wilmington, Del.; for two years, J. M. Camp, Duquesne, Pa.; C. A. Catlin, Providence, R. I.; Eugene Haanel, Ottawa, Canada; for three years, G. P. Adamson, Easton, Pa.; David Wesson, Wilmington, Del., and E. Gudeman, Chicago, Ill.

CONSTRUCTION NEWS

Supplement to ENGINEERING NEWS. New York, July 9, 1908.

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CONSTRUCTION NEWS.

PLANS AND SPECIFICATIONS ON FILE.

(denotes that this work is advertised in Engineering News.)*

The following Plans (P.) and Specifications (S.) are on file and may be seen at the office of The Engineering News Publishing Co., 220 Broadway, New York.

Bids close.	Work.	Place.	See issue.
7-10*	Water pipe,	Manchester, Mass. (S.)	6-25
7-11	Ash-handling,	Phila., Pa. (S.)	6-11
7-11	Derrick,	Bremerton, Wash. (S.)	6-25
7-13*	Lock, dam,	Vicksburg, Miss. (S.)	5-14
7-13	Pavements, etc.,	Mobile, Ala. (S.)	7- 2
7-13	Sewers,	Mobile, Ala. (S.)	6-25
7-15*	Channel,	Sunnyside, Wash. (S.)	6- 4
7-15*	Steel gates,	Nashville, Tenn. (P. & S.)	6-18
7-15*	Dam,	Traverse City, Mich. (P. & S.)	6-25
7-18	Boiler,	Ft. Terry, N. Y. (S.)	7- 2
7-18	Dry dock,	Bremerton, Wash.(S.)	6-11
7-18	Bridge,	Dayton, Ohio (P. & S.)	6-18
7-20*	Dredging,	Mobile, Ala. (S.)	6-25
7-22*	Dredging,	Newport, R. I. (S.)	6-25
7-23	Creek impvt. (Sewers),	Syracuse, N. Y. (P. & S.)	7- 2
7-25*	Piers,	Charleston, S. C. (S.)	6-25
7-27*	Aqueduct,	Los Angeles, Cal. (S.)	6- 4
7-27*	Waterway,	Wilmington, Del. (S.)	6-25
7-29*	Pumping plant,	New Boston, Ill. (P. & S.)	6-18
8- 1	Marine Ry.,	Key West, Fla... (S.)	7- 2
8- 1	Coal-handling plant,	N. Y. ..(S.)	7- 9
8- 1	Retaining wall, etc.,	Phila...(S.)	7- 9

LIST OF CONTRACTS PENDING.

LIGHT, HEAT AND POWER PLANTS.

7-10	Power plant,	Frankfort, Ky..... 7- 9
7-13	Wiring, etc.,	Cincinnati, O 7- 9
7-13	Elec. equipment,	New York, N. Y. 7- 2
7-15	Gas regulators,	New York, N. Y.. 7- 2
7-15	Light fixtures,	Washington, D. C. 7- 2
7-15	Distributing mains,	N. Chicago, Ill. 6-11
7-15	Trans. lines,	Toronto, Ont..... 6-11
7-15*	Dam,	Traverse City, Mich..... 6-25
7-18	Gas wells,	Medicine Hat, Alta.... 6-25
7-20	Wiring, etc.,	New York, N. Y..... 7- 9
7-23	Lighting,	Wilkes-Barre, Pa..... 6-18
8- 1	Power plant,	Townsend, Mont.... 6-11

BRIDGES.

7-10	Bridge,	Logan, Ohio 6-25
7-10	Bridge work,	Connersville, Ind... 6-11
7-10	Bridge,	Wheeling, Ill..... 7- 9
7-13	Bridges, etc.,	Newark, Ohio 7- 9
7-13	Retaining wall,	Shavertown, Pa.. 7- 9
7-14	Culvert,	Clinton, Iowa 7- 9
7-14	Bridges,	Houston, Tex. 7- 9
7-14	Bridge,	Lewiston, Idaho 6-18
7-14	Bridges,	Fargo, N. Dak..... 6-25
7-14	Arch, etc.,	Lander, Wyo..... 6-25
7-14	Bridge,	Mansfield, Ohio..... 7- 2
7-14	Substructures, etc.,	Bryan, Ohio. 7- 2
7-14	Bridge,	Middletown, Ohio..... 7- 2
7-14	Bridge,	Mason, Mich..... 7- 2
7-15	Bridge,	Westchester, Pa. 7- 9
7-16	Bridge approach,	Delphi, Ind..... 7- 2
7-16	Bridge,	Philipsburg, Pa..... 7- 2
7-16	Bridge work,	New York, N. Y.. 7- 2
7-18	Bridge,	Dayton, Ohio 6-18
7-20	Superstructures,	Frederickton, N. B. 6-18
7-21	Culverts,	Stillwater, Minn. 7- 9
7-24*	Bridges,	Philadelphia, Pa. 7- 9
7-25	Culverts, etc.,	New Phila., O..... 7- 9
7-28	Abutment,	Upper Sandusky, O.... 7- 9
7-29*	Bridge equipment,	Chicago, Ill.. 7- 9
8- 3	Bridge,	Granite, Okla..... 7- 2

BUILDINGS.

7-10	Vacuum system,	Chicago, Ill..... 6-11
7-11	Buildings,	Winnipeg, Man. 7- 9
7-11	Buildings,	Morganza, Pa. 7- 9
8-12*	Post-office,	Anderson, S. C..... 7- 2
7-13	Schools,	New York, N. Y..... 7- 2
7-13	Repairs,	Hartford, Conn. 7- 9
7-14*	Wrecking, etc.,	Chicago, Ill..... 5-28
7-15	Building,	Columbia, S. C..... 6 11
7-15*	Post-office, etc.,	Valdosta, Ga... 6-11
7-15	Bldg.,	Moose Jaw, Sask..... 7- 2
7-15	School,	Seattle, Wash..... 7- 9
7-15	School,	Moose Jaw, Sask..... 7- 9
7-15	Jail,	Baltimore, Md. 7- 9
7-16*	Fire escapes,	Bayonne, N. J. 7- 9
7-16	Ice plant, Ft. Dade, Fla.	(Mfg. Pl.) 6-25
7-16	Post-office,	Augusta, Me..... 6-11
7-17	Brick,	Atlanta, Ga..... 7- 2
7-20	Plans,	Providence, R. I..... 7- 2
7-20	Post-office,	Auburn, Me..... 6-11
7-20	Schools,	New York, N. Y. 7- 9
7-20	Court-house,	Rhinelander, Wis.. 7- 9
7-20	Machine shop, Ft. St. Philip, La.	(Mfg. Pl.) 7- 9
7-20	Quarters,	Watertown, Mass. 7- 9
7-20	Building,	Philadelphia, Pa. 7- 9
7-21	Bank,	Knoxville, Tenn. 7- 9
7-21*	Post-office,	Coldwater, Mich. 6-11
7-21*	Hospital,	Fairview, Pa..... 7- 2
7-22*	Post-office,	Paris, Tenn. 6-11
7-23	Post-office,	Alton, Ill..... 6-18
7-23	Building,	Iowa City, Ia. 7- 9
7-24	School,	Toledo, Ohio 7- 9
7-24*	Post-office,	Belleville, Ill. 6-18
7-27	Jail,	Laporte, Ind..... 6-25
7-27	Post-office,	Butte, Mont..... 7- 2
7-28	City-hall,	Augusta, Ga. 7- 9
7-29*	Elevators,	Spokane, Wash..... 7- 2
7-30*	Mech. plant,	Florence, Ariz. (Mfg. Pl.) 7- 2
7-30*	Buildings,	Florence, Ariz..... 7- 2
7-30*	Court-house,	Portland, Me..... 6-25
8- 1	Plans,	St. Paul, Minn. 4-30
8- 6*	Dwellings, etc.,	Riverton, Ala..... 7- 9
8-10*	Post-office, etc.,	San Francisco, Cal 7- 2
8-11*	Post-office,	Bedford, Ind. 7- 9
9- 1	School plans,	St. Paul, Minn. 7- 9
9-23	Court-house	Green Bay, Wis..... 6-18

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7-10*	Water pipes,	New Britain, Conn.. 7- 2
7-10*	Water pipe,	Spencer, Ind..... 7- 2
7-10	Water pipe,	Springfield, Ohio..... 7- 2
7-10*	Cast-iron pipe,	Manchester, Mass. 6-25
7-10*	Filters,	Reading, Pa. 6-18
7-11	Pipe-laying, hydrants, etc.,	Newark, Ohio..... 7- 2
7-13*	Boilers, etc.,	Cincinnati, O..... 6-18
7-13	Water-works bonds,	Minot, N. Dak. 6-25
7-13	Engine,	East Orange, N. J. 7- 9
7-15	Water system,	Ames, Iowa 7- 9
7-15	Canal,	Richfield, Utah 7- 2
7-15*	Channel,	Sunnyside, Wash..... 5- 7
7-15	Water-works,	Bennettsville, S. C.. 7- 2
7-15	Pumping engine,	Brooklyn, N. Y.. 7- 2
7-18	Boiler,	Ft. Terry, N. Y..... 7- 2
7-20	Water system,	Oxford, Ohio..... 7- 2
7-20	Pumping engine, etc.,	Victoria, B. C..... 7- 2
7-20*	Water-works,	West Branch, Mich. 7- 9
7-20	Water-works,	Templeton, Iowa.. 7- 9
7-21*	Water-works,	Burlington, N. C.. 7- 9
7-22	Well,	Jamesburg, N. J. 7- 9
7-22*	Water-works,	Nowata, Okla. 7- 9
7-23*	Aqueduct,	New York, N. Y..... 7- 2
7-27*	Aqueduct,	Los Angeles, Cal. 6- 4
7-27*	Pump,	Houston, Tex. 6- 4
7-29*	Pumping plant,	New Boston, Ill. 6-18
8- 4	Water system,	Bremerton, Wash. 7- 9
8-27	Dam,	Orland, Cal. 6-11

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7-10	Sewer,	Andalusia, Ala..... 6-18
7-10	Sewer,	Hammond, Ind. 7- 9
7-11	Sewers,	Woodsfield, Ohio 7- 9
7-13	Sewer,	Bellingham, Wash. 7- 9
7-13	Drain,	River Edge, N. J. 7- 9
7-13	Sewers,	Derry, Pa. 7- 9
7-13	Sewers,	Akron, Ohio 7- 9
7-13	Sewers,	Mobile, Ala..... 6-25
7-13	Sewer,	Wabash, Ind..... 6-25
7-13	Sewer,	Cincinnati, Ohio..... 7- 2
7-14	Sewer,	Guthrie, Okla. 7- 9
7-14	Sewer,	Milan, Mich. 7- 9
7-16	Sewer,	Ft. Wayne, Ind. 7- 9
7-17	Sewers,	Two Rivers, Wis. 7- 9
7-17	Sewers,	St. Louis, Mo. 7- 9
7-17*	Sewer,	Louisville, Ky. 6-25
7-18	Sewer,	New Bremen, Ohio..... 7- 2
7-20*	Sewer pipe, etc.,	Okmulgee, Okla. 7- 2
7-23	Sewer,	Cleveland, Ohio..... 7- 2
7-23	Sewer system,	Syracuse, N. Y.... 7- 2
7-24	Sewers,	Pratt, Kan..... 6-25
7-24	Sewers,	Janesville, Wis. 7- 9
7-24	Sewers,	Philadelphia, Pa. 7- 9
7-28*	Sewer,	Portsmouth, Va..... 6-25
7-31*	Sewer,	Boston, Mass. 7- 9

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7- 9	Paving,	Dubuque, Iowa 7- 9
7-10	Grading, arch,	Connersville, Ind. 6-18
7-10	Sidewalks,	Clarksburg, W. Va.... 7- 2
7-10*	Grading, etc.,	Rogersville, Tenn.. 7- 2
7-10	Road impvt.,	Cincinnati, Ohio.... 6-25
7-10	Road,	Rushville, Ind..... 6-11
7-11	Road,	Crawfordsville, Ind. 6-18
7-11	Street impvt.,	Cheviot, Ohio..... 6-25
7-11	Pavement,	San Antonio, Tex..... 6-25
7-11*	Paving, etc.,	Washington, D. C... 6-25
7-11*	Grading,	Washington, D. C..... 7- 2
7-13*	Paving,	Silver Creek, N. Y. 7- 9
7-13	Paving,	Weehawken, N. J. 7- 9
7-13	Asphalt,	Hartford, Conn. 7- 9
7-13	Road impvt.,	St. Paul, Minn..... 7- 2
7-14	Roadway,	Sonyea, N. Y..... 7- 2
7-14	Pavement,	Red Oak, Iowa..... 7- 2
7-14	Road,	Houston, Tex. 7- 2
7-14	Grading,	Pasadena, Tex. 7- 9
7-14*	Paving,	Woodbury, N. J. 7- 9
7-15*	Paving,	Owosso, Mich. 7- 9
7-15	Macadam,	Escanaba, Mich. 7- 9
7-15	Road,	Newport, Ind..... 7- 2
7-15	Grading,	Cleveland, Ohio 6-18
7-15	Regulating, etc.,	Long Island City (L. I.), N. Y..... 7- 2
7-17	Road impvt.,	Cincinnati, Ohio.... 6-25
7-17*	Road,	Fort Mott, N. J..... 6-25
7-17	Grading, etc.,	Olympia, Wash. 7- 9
7-18*	Grading, etc.,	Washington, D. C. 7- 9
7-20	Sidewalks,	Dunkirk, Ind. 7- 9
7-20	Road,	Wilkes-Barre, Pa. 7- 9
7-20	Roads,	Emporia, Va. 7- 9
7-21	Roadway,	Charleston, S. C. 7- 9
7-21	Sidewalk,	Palatka, Fla..... 6-25
7-24	Road,	Decatur, Ind..... 7- 2
7-24*	Road impvt.,	Hackensack, N. J.. 7- 9
8- 1*	Macadam,	Hillsdale, N. J..... 7- 9
8- 3	Grading, etc.,	Jacksonville, Fla. 7- 9
8- 4*	Grading, etc.,	Rome, Ga. 7- 9

MISCELLANEOUS.

7-10*	Light-house,	Wilmington, Del... 6-25
7-10	Vacuum clean. system,	Chicago.. 6-11
7-11	Ash-handling plant,	Phila., Pa... 6-11
7-11	Derrick,	Bremerton, Wash..... 6-25
7-13*	Lock, dam,	Vicksburg, Miss.... 5-14
7-13*	Lock and dam,	Harrisonburg, La. 6- 4
7-13	Retaining wall,	Wilkes-Barre, Pa. 7- 2
7-13	Channel,	Port Colborne, Ont. .. 7- 9
7-14*	Repair. pier,	Grand Rapids, Mich. 7- 2
7-14	Drainage,	Forest City, Iowa 7- 9
7-15	Traveling cranes,	New York..... 7- 2
7-15	Trent Canal,	Ottawa, Ont..... 7- 2
7-15*	Steel gates,	Nashville, Tenn.... 6-18
7-15*	Channel impvt.,	Des Moines, Ia.. 6-25
7-16	Walls, roof, etc.,	Boston, Mass.... 7- 9
7-16	Lumber,	New York, N. Y. 7- 9
7-16	Painting railing,	New York 7- 9
7-17	Dredging,	Osterville, Mass. 7- 9
7-17*	Timber,	Detroit, Mich. 6-25
7-17*	Removing rock,	New York..... 6-25
7-18	Dry dock,	Bremerton, Wash... 6-11
7-18*	Sea wall, etc.,	Wilmington, Del.. 7- 2
7-20*	Dredging,	Mobile, Ala. 6-25
7-20	Lumber,	New York, N. Y. 7- 9
7-21*	Barge canal,	Albany, N. Y. 6-25
7-21*	Dredging,	Detroit, Mich 6-25
7-21	Scows,	New York, N. Y. 7- 9
7-22*	Dredging,	Newport, R. I. 6-25
7-23*	Creek impvt.,	Syracuse, N. Y.. 6-25
7-23*	Refuse disposal,	New York, N. Y. 7- 2
7-25*	Piers,	Charleston, S. C..... 6-25
7-27*	Waterway,	Wilmington, N. C.... 6-25
7-28*	Stone,	New York, N. Y. 7- 9
7-28*	Garbage,	New York, N. Y. 7- 9
7-31	Engines,	Prince Albert, Sask 7- 9
7-31*	Wharf,	Fort Mott, N. J. 7- 9
7-31	Dredging,	Bangor, Me. 7- 2
8- 1*	Quay wall,	Key West, Fla. 6-25
8- 1*	Marine railway,	Key West, Fla.. 7- 2
8- 1	Retaining wall, etc.,	Phila., Pa. 7- 9
8- 1	Coal-handling plant,	N. Y..... 7- 9
8- 6*	Pier, shed,	San Francisco, Cal.... 7- 2
8-14	Light-house,	Alaska 5-21
9- 1	Monument designs,	Mexico 5-21

CIVIL SERVICE.

7-15	Pharmacognosist,	Wash., D. C. .. 7- 9
7-22	Jr. Arch. Draftsman,	Wash., D. C. 7- 9
7-22	Auditing Clerk,	Philippines 7- 9
7-22	Elec Engr., Mech. Drftsmn,	Wash. 7- 9
7-24	Ceramic Chemist,	Wash., D. C.. 7-16
7-25	Economic Geology Asst.,	Albany. 7-16
7-25	Eng. Examiner,	Albany, N. Y..... 7-16
7-25	Interpreters,	Albany, N. Y. 7-16
7-25	Leveler,	Albany, N. Y. 7-16
7-25	Structural Engr.,	Albany, N. Y.. 7-16
7-29	Asst. Chemist,	Wash., D. C. 7-16

RAILWAYS.

ANNISTON & COLUMBUS.—The franchise granted to the company by city of Anniston, Ala., has been amended. Company may begin work any time within three years from the date of the ordinance, July 2, 1907. W. H. Weatherly, of Anniston, Ala., is Pres.

BUCKHANNON & NORTHERN.—The County of Monongalia, W. Va., has granted a franchise to the Buckhannon & Northern R. R. for the use of the bridge across the Monongalia River at Morgantown, W. Va. The cash consideration paid was $10,000. This is the first actual step in the execution of the plans for the new road. It will extend from Buckhannon, W. Va., to Pittsburg and will open up coal land and oil fields. It will be about 85 miles long. S. D. Brady is Ch. Engr., Parkersburg, W. Va.

CHARLOTTE HARBOR & NORTHERN.—Construction of the extension from Arcadia, Fla., north to Plant City, 60 miles, will be started this year. Surveys are made and right-of-way secured. L. M. Fouts, Jacksonville, Fla., is Gen. Mgr.

CHICAGO, BURLINGTON & QUINCY.—We are officially advised that location surveys have been made for a spur from Cheyenne, Wyo., to Fort D. A. Russell, Wyo., but that nothing has been done about its construction yet.

GOULD SOUTHWESTERN.—We are officially informed that this company will not let contracts for building an extension from Webber to Star City, Ark., ten miles, but will build the line with its own forces. T. S. Estabrook, Vice-Pres., Fisher Bldg., Chicago. Surveys are made; right-of-way and capital have been secured. S. G. McClellan is Gen. Mgr., Gould, Ark.; E. C. Buchannan is Ch. Engr., Little Rock, Ark.

KANSAS CITY TERMINAL RY.—This company has made arrangements, through John J. Mitchell, of Chicago, to issue $15,000,000 of bonds for the purpose of enlarging the terminal facilities at Kansas City, it is stated. The Kansas City Terminal Ry. was organized to construct an improved passenger terminal and approaches for the railroads entering Kansas City, Mo. Ten railroads, including the Union Pacific, the Atchison, Topeka & Santa Fe, the Chicago, Burlington & Quincy, the Chicago, Milwaukee & St. Paul, the Chicago, Rock Island & Pacific, the Missouri Pacific, and the Wabash control the Kansas City Terminal Ry. It has an authorized stock issue of $50,000,000. The company has outstanding $3,000,000 of 4½% short-time obligations, which were sold to supply funds until a permanent bond issue was arranged.

LOUISIANA.—We are officially advised that the Southern Mineral & Land Improvement Co., of New Orleans, will let contracts in about 30 days for the construction of five miles of railroad from Winfield, La., to its quarry. Surveys are made, right-of-way secured and capital is being obtained. I. L. Lyons is Pres.; R. M. Walmsley, Charles C. Carroll, Warren Kearny, Gustaf R. Westfeldt and others, all of New Orleans, are the directors. J. F. Coleman, Hibernia Bank Bldg., New Orleans, is Ch. Engr.

MEXICO.—A transfer has been made whereby a new company organized under the laws of Mexico with the name Ferrocarril Veracruz al Istmo, S. A., has acquired the entire property of the Vera Cruz & Pacific Ry. with the purpose of making extensions of its lines into the rapidly developing country along its route. This transfer is in effect simply a reorganization of the company with a different charter. The old Vera Cruz & Pacific Co. was organized under the laws of the United States. All the shares of stock has been in the possession of the Mexican Government. Thomas Milan, Vera Cruz, Mexico, is Pres. and Gen. Mgr. It is not probable that the proposed extensions will be commenced for some months or until traffic conditions in the republic improve. The V. C. & P. operates 265 miles of railroad.

MOUNT STERLING, COLUMBIA & SCOTTSVILLE.—Incorporated in Kentucky with capital stock of $2,000,000. The main office is to be in Mount Sterling, Ky., from which the road will start. Under the agreement, the citizens here are to pay $45,000 to the company as follows: $25,000 when the road is built to the Lexington & Eastern Ry.; $10,000 when completed to the Louisville & Atlantic R. R.; and $10,000 when completed to the Louisville & Nashville R. R. J. F. Allen, Cincinnati, Ohio, is the promoter.

NATIONAL LINES OF MEXICO.—Kuhn, Loeb & Co., Speyer & Co., Ladenburg, Thalmann & Co., and Hallgarten & Co., of New York, have arranged the sale of $30,000,000 4% general mortgage bonds, guaranteed by the Mexican government, to a group of French bankers. Contract has been let to CAMPBELL & SAUTER, Durango, State of Durango, Mex., for lumber for the National Lines. The material purchased involves an expenditure of $1,500,000 by the railway company. All kinds of railroad timbers and lumber are involved in the contract, including cross-ties, telegraph poles, bridge timbers, car sills, sidings and various other forms of lumber that enter into railroad construction and car building. The delivery of this material is to begin immediately.

NEBRASKA.—M. K. Dunbar, Kansas City, Mo., will incorporate company to build a railroad from Benkelman, Neb., to a point in Kansas or Colorado.

NORFOLK & SOUTHERN.—On July 1 this company was placed in the hands of Thomas Fitzgerald, Harry K. Wolcott and Hugh M. Kerr of Norfolk, Va., as receivers, by United State Judge Waddill. The appointment of the receivers was upon a bill filed in the United States Circuit Court by the Trust Company of America, trustees under a mortgage of the railway company. Thomas L. Chadbourne, Jr., of New York, represented the trust company and Edward R. Baird, Jr., of Norfolk, the railway in the receivership proceedings. Mr. Fitzgerald, formerly Gen. Mgr. of the Baltimore & Ohio R. R. Co., will be General Manager of the Norfolk & Southern for the receivers. Edward R. Baird and George Rublee of New York have been designated as counsel for the receivers. The receivers have given $100,000 bonds. There was no opposition to the receivership. This company operates a railway from Norfolk, Va., to New Bern and Raleigh, N. C., with several branch lines, a total of about 600 miles. About 100 miles of extensions will be built, the most important part of which is a bridge across a portion of Albemarle Sound, N. C., which had to be suspended some time ago, in consequence of lack of funds. The road traverses a rich timber country.

TEXAS.—An approximate statement of railroad mileage constructed in Texas during the year ending June 30, 1908, is as follows: Beaumont & Great Northern—Onalaska to Livingston, 12.90 miles. Beaumont, Sour Lake & Western—Sour Lake to Houston, 64.28 miles; Burr's Ferry, Browndel & Chester—Aldridge to Turpentine, 4.02 miles; Chicago, Rock Island & Gulf—Irving to Carrollton, 10.82 miles; C. R. I. & G.—Amarillo to Wildorado, 21.30 miles; Galveston Terminal—In the city of Galveston (main line), 4.26 miles; Kansas City, Mexico & Orient—Knox City to Truscott, 22.50 miles; San Angelo north, 12.00 miles; both 34.50 miles; Roscoe, Snyder & Pacific—Roscoe to Snyder, 30.21 miles; St. Louis Southwestern—Warsaw to Broaddus, 6 miles; Southern Kansas—Between Panhandle and Amarillo (net), 10.90 miles; Southwestern of Texas—Henrietta to Scotland, 19.55 miles; Stephenville, North & South Texas—Stephenville to Hamilton, 42.70 miles; Texas & New Orleans—Port Arthur Branch, 3.70 miles; Texas State R. R.—Rusk to Meshaw, 15.70 miles; Weatherford, Mineral Wells & Northwestern—Mineral Wells to Graford, 20.64 miles; Wichita Falls & Southern—Wichita Falls to Olney, 39.70 miles; total 341.18 miles. Mileage constructed on June 30, 1907, as shown by the annual report of the Railroad Commission (1907), 12,575.56 miles. Total approximate mileage in Texas on June 30, 1908, 12,916.74 miles. The above does not include electric interurban railroad in operation in Texas as follows: Denison & Sherman—Denison to Sherman, 8 miles; North Texas Traction—Dallas to Fort Worth, 32 miles; Temple & Belton Electric, 8 miles; Sherman & Dallas Electric, 64 miles. Total 112 miles. Neither does the above include about 300 miles of private railroad, logging roads, tram roads, etc., which serve only private industries such as lumber and planing mills, and which are not recognized by the State Railroad Commission as common carriers.

Railroads under construction on June 30, 1908, in Texas, or upon which some actual

construction work has been done are as follows—(on some of these railroads work is for the present suspended): Burr's Ferry, Browndel & Chester—Turpentine to Browndel, 19 miles; Kansas City, Mexico & Orient—Truscott to Red River, 58 miles; Sweetwater south, 65 miles; Port O'Connor, Rio Grande & Northern—Yoakum to Port O'Connor, 75 miles; Texas State R. R.—Meshaw to Palestine, 15 miles; Wichita Falls & Southern—Olney south, 15 miles; Chicago, Rock Island & Gulf—Wildorado to Texas-New Mexico state line, 49 miles. Total, 296 miles.

Railroads that have been chartered and projected for construction that are considered to be the most substantial projects. (These do not however include all railroads that are chartered and projected for construction in Texas): Abilene & Ballinger—Abilene to Ballinger, 53 miles; Colorado, Hereford & Gulf—State line via Dalhart to San Angelo, 420 miles; Gulf, Santa Fe & Northwestern—Brownwood to Texico, 350 miles; Estacado & Gulf—Roby to Coleman, 100 miles; Kansas City, Mexico & Orient—San Angelo to Rio Grande, 314 miles; San Angelo to Del Rio, 160 miles; Port Arthur & Houston Short Line—Port Arthur to Dumont, 80 miles; Sabine Valley—Marshall to Port Arthur, 200 miles; South Texas & Gulf—Artesia to Carrizo Springs, 40 miles. Total, 1,723 miles.

VERA CRUZ & PACIFIC.—See "Mexico."

LONDON, ENGLAND.—Official announcement has been made that the directors of the Great Northern, Great Central and Great Eastern Railway companies have decided to seek Parliamentary powers with a view to entering into a working agreement based upon the arrangements recently approved by the shareholders of the Great Central and Great Northern companies. It is further stated that the three companies have already made arrangements for co-operation in connection with the movement of their traffic, which will tend towards economy of working.

ELECTRIC RAILWAYS.

HOPKINTON, R. I.—The Ashaway & Westerly R. R. Co. has awarded contract for building its line to ALLEN & PHELPS, Norwich, Conn. It will be about five miles long. Noted fully on June 11.

WILLIMANTIC, CONN.—The New York, New Haven & Hartford R. R. Co. has completed preliminary arrangements for building a trolley line from Willimantic to South Coventry and has filed with the Railroad Commissioners an application to have the proposed method of construction formally approved. The needed local franchises have been procured from the city of Willimantic and the towns of Mansfield and Coventry. M. T. Rider, Ch. Engr., New Haven, Conn.

TROY, N. Y.—The United Traction Co., Albany, N. Y., has applied for an extension of time to July 1, 1909, for the performance of certain work in construction in Troy, for which franchises have been awarded. Edgar S. Fassett is Gen. Mgr., Albany.

PATERSON, N. J.—We are officially advised that plans and specifications are being prepared by the New York & North Jersey Rapid Transit Co. for the construction of an interurban electric railroad between Paterson, N. J., and Suffern, N. Y., preparatory to letting contracts. M. R. McAdoo, Colt Bldg., Paterson, N. J., is Gen. Mgr.

LYKENS, PA.—J. W. Moyer, Pres. of the Schuylkill & Dauphin Traction Co., Pottsville, Pa., advises us that surveys are in progress and right-of-way is being obtained. Capital is partly secured. Contracts will be let when engineering work is completed, which probably will not be for nine months. The line will connect Reinerton and Rainer City; Lykens and Berrysburg and Ashland and Millersburg, and will be 63 miles long. The same company operates the Lykens & Williams Valley Elec. St. Ry., twelve miles long, from Lykens to Reinerton. E. L. Boyd is Ch. Engr., Tamaqua, Pa.

FREDERICK, MD.—We are officially informed that contract has been let to J. E. McDONALD & CO., Frederick, by the Washington, Frederick & Gettysburg Railway Co., for the extension of its line from Jewistown, Md., to a connection with the Monocacy Valley R. R., about 3½ miles. D. Columbus Kempt is Pres.; H. T. Carmichael is Ch. Engr., and A. C. McBride is Gen. Mgr., at Frederick. The line will be about 65 miles long when completed, extending from Great Falls, Va., to Gettysburg, Pa.; 14 miles are now constructed and 3½ miles are under construction by McDonald & Co. Noted on May 21.

DURHAM, N. C.—The Suburban Land & Power Co. has been incorporated with $40,000 capital, which may be increased to $25,000,000, to build and operate an electric railway in and near Durham, to be not more than 50 miles of line. The incorporators are E. J. Parish, J. M. M. Gregory, John Sprunt Hill, W. W. Whitted and R. W. Winston.

YAZOO CITY, MISS.—The Rapid Transit Co. has been incorporated with capital stock of $10,000, by T. F. Davis, W. A. Henry, Jr., and others. Mr. Henry advises us that "this is simply an automobile line and not a street railway as the name suggests. The company runs two 20-passenger automobiles, and probably will install a third."

DAYTON, OHIO.—Construction work will be commenced soon by the Cincinnati, Dayton & Fort Wayne Ry. Co. on its proposed standard-gage third-rail line which will run from Cincinnati to Dayton, Ohio, and Fort Wayne, Ind., a distance of 194 miles. Power stations will be built at Seven Mile and Celina, Ohio. Repair shops will be located at West Elkton, Ohio. Company contemplates furnishing power for lighting. Capital stock authorized, $3,000,000; issued, $450,000. Bonds authorized, $2,000,000. Headquarters, 51 Davies Bldg., Dayton, Ohio. Officers: S. F. George, Dayton, Pres. and Gen. Mgr.; D. W. La Fetra, New York, First Vice-Pres.; Chas. L. Hyde, Pierre, S. Dak., Second Vice-Pres.; Wm. D. Freeman, Dayton, Secy. and Treas.; B. B. George, Dayton, Purchasing Agent.

CHICAGO, ILL.—David R. Forgan and John M. Roach have been appointed receivers for the Chicago Consolidated Traction Co. by Judge Grosscup. The action was taken on a petition by the Central Trust Co. of New York, trustee of the Equitable Trust Co. of Chicago, which holds a mortgage covering the properties of the traction company. The bill for a receiver was filed in the United States Circuit Court several weeks ago. Mr. Forgan, who is Pres. National City Bank, of Chicago, will give his attention to the financial affairs of the company, while Mr. Roach will take charge of the operations of the lines. Mr. Roach is Pres. and Gen. Mgr. of the Consolidated Traction Co., which operates 182 miles of railway.

EMMETSBURG, IOWA.—M. H. Miller, Vice-Pres. of the Spirit Lake, Emmetsburg & Fort Dodge R. R. Co., Fort Dodge, Iowa, informs us that date for letting construction contracts will be decided by the new officers of the company who will be elected by the stockholders on July 13. Preliminary survey has been made. As noted on May 21, this railway will be built from Fort Dodge to Emmetsburg and Spirit Lake, 110 miles. Greater part of the right-of-way is secured. Capital has been partly obtained. The company may operate an amusement park seven miles north of Fort Dodge, and also furnish current from its own power station to towns along the route. The repair shops are to be located at Emmetsburg. The officers of this company are as follows: T. F. McCartan, Pocahontas, Pres.; M. H. Miller, Fort Dodge, Vice-Pres. and Acting Gen. Mgr.; P. O. Reisell, Emmetsburg, Secy., and D. O. Johnson, Emmetsburg, Treas. The Spirit Lake, Emmetsburg & Fort Dodge Railway was incorporated on July 11, 1907. Capital stock, $50,000.

ARKANSAS CITY, KAN.—The Union St. Ry. Co. has just been voted $20,000 in bonds by Arkansas City to aid the construction of its electric interurban railway between Arkansas City and Winfield. D. H. Siggins, of Coffeyville, Kan., is Pres.

GRAND FORKS, N. DAK.—E. J. Lander, John Dinnie, W. H. Kelsey, E. S. Kent and O. A. Webster have applied for a franchise to operate a street railway system in Grand Forks.

OREGON, MO.—Contract has been awarded by the Oregon Interurban Ry. Co. to M. A. HOGAN, Kansas City, Mo., for the construction of 4½ miles of railroad from Oregon to Forest City, Mo. The approximate quantities are: 60,000 cu. yds. of excavation; 47,000 cu. yds. of embankment; 62,600 ft. of timber and lumber; 2,000 lin. ft. of piling, 16 to 35 ft. long; 405 tons of 56-lb. relay steel rails; 13,000 ties; one steel bridge, 60-ft. span; 4½ miles of tracklaying. B. F. Morgan, Oregon, Mo., is Pres.; George Custer, Marysville, Mo., Engr. Noted on May 28.

SAN ANGELO, TEX.—T. M. Vaughan, Secy. of the Angelo Power & Traction Co., informs us that company is building its railway with its own forces. As noted last week, the company about Sept. 15 will be in the market for material for further construction. It will be three miles long. E. E. Bailey is Pres.; J. H. Ransom, Vice-Pres. and Assistant Gen. Mgr.; W. D. Fuller, Gen. Supt.; T. M. Vaughan, Secy.; John W. Harris, Treas., San Angelo.

CONDON, ORE.—The Wasco County Elec. & Power Co. has let contract to the PORTLAND CONSTRUCTION CO., 318 Marquam Bldg., Portland, Ore., for building its proposed electric railway south from Condon to Antelope, Madras and Bend. Branches will be built to Howard and Dayville. The company also plans the construction of power stations on the Deschutes and John Day Rivers. It is announced that construction work will be begun shortly. Officers: G. S. Carpenter, Fossil, Pres.; Dr. H. L. Koeney, Portland, First Vice-Pres.; R. L. Hunt, Condon, Second Vice-Pres.; E. P. Schow, Portland, Secy.; C. W. Lord, Condon, Asst. Secy.; F. T. Hurlburt, Condon National Bank, Treas.; R. L. Donald, Portland, Gen. Mgr.; J. C. Stevens, Portland, Supt.; D. R. Parker, Condon; C. D. Charles, Mark W. Gill, F. S. Munn, O. B. Hathaway, and H. J. Martin, Portland, are directors. Noted on June 18.

HOLBROOK, ARIZ.—H. Lee Chilson, Secy. of the Navajo Improvement Co., Winslow, Ariz., advises us that this company probably will let construction contracts by Oct. 1. It will build a railway, to be operated by steam or electricity, between Holbrook and Fort Apache, Ariz., a distance of 100 miles. Surveys are being made now. Right-of-way is being obtained. Capital is promised. E. S. Campbell, Prescott, Ariz., is Pres.; Thos. Maddox, is Ch. Engr., Williams, Ariz. Noted on May 21.

LIGHT AND POWER PLANTS.

(* *denotes that this work is advertised in Engineering News.*)

PROVIDENCE, R. I.—Plans are being made by the Narragansett Electric Lighting Co. for increasing the output of its plant this summer. It is proposed to install a 3,000-KW. steam turbine. The present output of the plant is about 15,000 KW.

ALBANY, N. Y.—The Mohawk Power Co. has made application to the Public Service Commission, Second District, for permission to issue $100,000 of capital stock with which to begin operations. As there has arisen some question as to the legality of the bonds issued by the Niskayuna Power Co., that company is to be dissolved, and the Mohawk Power Co. has been formed for the purpose of continuing the work. The Mohawk Power Co. will supply gas and electricity through the valleys of the Hudson and Mohawk Rivers and will have its principal office at Glens Falls. The company plans to erect and maintain dams across the Mohawk River in the counties of Schenectady, Albany, Saratoga, Montgomery and Herkimer, and on other tributary streams; also across Garoga Creek in Montgomery and Fulton Counties; and to construct and operate all necessary power houses, plants, machinery buildings and other structures. The names of the municipalities in which the company's operations will be carried on are: Villages of Sandy Hill, Fort Edward, Corinth, Saratoga Springs and Ballston; cities of Glens Falls, Albany, Troy, Watervliet, Cohoes, Schenectady, Amsterdam, Johnstown, Gloversville, Little Falls, Utica, Watertown and Syracuse. The directors are Eugene L. Ashley, Glens Falls; Elmer J. West, Glens Falls; Charles E. Parsons, Albany; Bryce E. Morrow, Schenectady, and Patrick F. Eoohan, Saratoga Springs.

NEW YORK, N. Y.—The contract for furnishing the electric equipment for the University Heights bridge was awarded to the SPIRO CO., 114 East 14th St., New York, for $6,600, by J. W. Stevenson, Comr. Dept. of Bridges.

NEW YORK, N. Y.—Bids are asked by C. B. J. Snyder, Supt. School Bldgs., Dept. of Education, until 11 a. m., July 20, for installing electric light wiring, fixtures and fire-signal system, etc., in Public School No. 43, on the northerly side of Boerum St. and the southerly side of Johnson Ave., between Manhattan Ave. and Leonard St., Boro. of Brooklyn.

PITTSBURG, PA.—The contract for the erection of a power house at the city farm has been awarded by George W. Guthrie, Mayor, to D. T. RIFFLE, Fulton Bldg., whose bid was $26,889.

PULASKI, VA.—Edgar C. Wiley, of Lynchburg, will prepare plans for the hydro-electric power plant, the cost of which is estimated at $50,000. An election will be held July 10 to vote on the proposition to issue $75,000 of bonds for construction of the plant. John T. Loving is Mayor.

BUCHANAN, VA.—James P. Wood, Roanoke, Va., has purchased and will develop water-power at Little Tunnel, on James River, in Botetourt County, about nine miles from Buchanan. It is proposed to construct tunnel and dam, and it is estimated that a 3,000-HP. will be obtained.

NOTTOWAY, VA.—The Kennedy-Walker Land & Development Co., Kenbridge, Va., has made the survey of Crystal Lake, near Nottoway, with view of development to supply electric light and power. C. H. Moorefield and W. N. Preas, of the Virginia Polytechnic Institute, Blackstone, Va., are in charge. It is planned to construct a flume for conveying waters of the Little Nottoway River into Crystal Lake.

WASHINGTON, GA.—Plans are being made by the Anthony Shoals Power Co. to develop the property on the Broad River in the Northern part of Wilkes County soon. It is stated that the company proposes to erect transmission lines and distribute electricity in Washington, Augusta and Elberton for commercial purposes. T. M. Patrick, of Washington, Ga., is interested.

COLUMBIA, ALA.—Charles Davis contemplates developing 500 HP. Eventually about 800 HP. will be developed.

UNIVERSITY, MISS.—We are officially advised that contract for constructing a steam power plant for the University of Mississippi was let on June 30 to B. F. BARBOUR, 2119 Third Ave., Birmingham, Ala. The plant will cost $35,000. F. G. Proutt, Memphis, Tenn., is Engr.; D. M. Kimbrough is Chn. Bldg. Com., Oxford, Miss.

FRANKFORT, KY.—Bids are asked until July 10 by the State Board of Capitol Commission, Frankfort, for erection of power-house for new State Capitol building at Frankfort and for installation of mechanical equipment. Frank M. Andrews & Co., 25 East Third St., Cincinnati, Ohio, are Archs.

MAYFIELD, KY.—The Mayfield Water & Light Co., 521 Broadway, Mayfield, Ky., intends to install 300-KW. and 500-KW. direct-connected 2,300-volt 60-cycle 3-phase alternators to cross-compound non-condensing engines operating at 150 R. P. M. and 150 lbs. steam. W. E. Playter is Engr.

CINCINNATI, OHIO.—Bids are asked until noon, July 13, by the Board of Public Service, John J. Wenner, Clerk, for rewiring and remodeling the electric installation in the buildings of the House of Refuge.

EVANSVILLE, IND.—F. H. Goodrich and John G. Hester, of Flint, Mich., who have been awarded the franchise to build a gas plant in this city, probably will begin construction as soon as a site has been selected.

INDIANAPOLIS, IND.—We are officially advised that extensions are to be made to the plant of the People's Light & Heat Co., lately reorganized. The new company has acquired the coal mines of the Fauvre Coal Co., in Vigo County, several miles west of Terre Haute. Here the company proposes to establish a central power plant, in which to generate electric power, and from which to distribute it throughout a field that is expected eventually to include the cities and towns of central and western Indiana and eastern Illinois. Plans and specifications are being made to build a plant first that will produce about 5,000 HP. of electric power, and will deliver this on a line to run through Terre Haute, Brazil, Greencastle, Danville and Plainfield to Indianapolis. Paul H. White, Indianapolis, is Secy. and Treas.

*TRAVERSE CITY, MICH.—Plans and specifications for the concrete dam to be built by the Boardman River Electric Light & Power Co. at Traverse City, are on file at the office of Engineering News, New York. Bids are asked until July 15. Noted on June 25.

MARQUETTE, MICH.—The contract for the construction of the sub-station in connection with the Municipal Electric light plant has been awarded to the WESTINGHOUSE ELECTRIC & MFG. CO., Westinghouse Bldg., Pittsburg, Pa., for $8,000. R. Retallio is Supt.

DIMONDALE, MICH.—The Michigan Power Co., of Lansing, Mich., the corporation owning the water power site, which includes the dam at Dimondale, has arranged to begin work at an early date on concrete dam at this site. It will for furnishing electric power and lighting for a number of towns and It is proposed to complete the work

EAST ST. LOUIS, ILL.—An electric plant is to be established in East by the Consumers' Electric Light Co. The directors are J. Sweeney ander Flannigan and William H. East St. Louis.

BUHL, MINN.—Bids will be received Village of Buhl, Minn., until 8 p. 21, for changes and improvements works and electric light plant, consisproximately of 75-KW. 220-volt, direct, direct connected dynamo, with compensator set, or instead a 3-wire switchboard; two 150-HP. high boilers; 125-HP. high or medium speed matic engine, surface condenser, feed pump, closed heater and piping, stalled complete; also brick building 73 ft. Oscar Claussen, German A Bank Bldg., St. Paul, Minn., is Engr Nichols is Reedr.

GENOA, NEB.—John W. Early, lumbus, Neb., has been engaged by lage Council to prepare plans for proposed municipal electric light syste The cost of the plant is estimated at $11

ATCHISON, KAN.—Contracts for ing the municipal electric light plant awarded in the near future. The cost work is estimated at about $30,000. Giddings is City Engr.

DODGE CITY, KAN.—Plans are pleted for building a transmission line the Arkansas River Valley in Western sas and Eastern Colorado from Canon City, Colo., to Dodge City. Electricity furnished for irrigation purposes. Fr G. Austin, of Garden City, Kan., is said to be interested in the project.

MOUNDRIDGE, KAN.—Plans and estimates are being prepared by Burns & McDonnell, Kansas City, Mo., for an electric light and water-works system at Moundridge. When the estimates are received the question of a bond issue for this purpose will be submitted to the voters.

MITCHELL, S. DAK.—The Mitchell Power Co. has purchased a site and will erect a power-house costing $6,000. The company contemplates improving the entire electric system of the city. The work in full will cost about $50,000.

LINDSAY, OKLA.—The city electric light and water-works plants will be constructed at a cost of $7,000. After bonds are sold bids will be received for equipment. M. A. Earl & Co., Muskogee, Okla., are Engrs.-in-Charge.

ARVADA, COLO.—George Pullman Singer, of Denver, Colo., J. M. Blincoe, of Arvada, and C. W. Lothrops, Continental Bldg., Denver, have secured a franchise to furnish Arvada with electric light. They filed incorporation papers with the Secretary of State for the Arvada Electric Co. They will spend $32,000 on a transformer plant in the town, to be furnished with power by the Denver Gas & Electric Co. The plant will provide electricity for light and fuel purpose and for generating power. Later the company will operate in other parts of Jefferson County.

SALEM, ORE.—The DES MOINES BRIDGE & IRON CO. of Des Moines, Iowa, has secured the contract for constructing boiler, smokestack and addition to power-house at the Salem Indian School, at $8,188.

CORONA, CAL.—George I. Lamy, Union Trust Bldg., Los Angeles, Cal., has purchased the water rights of Lake Elsinore and pipe the water to Corona for power purposes. It is planned to drain Lake Elsinore and construct a power plant on the banks of the Santa Ana River, 35 miles away. The contemplated improvements will cost $50,000. The lake is 1,250 ft. above sea level. It is two miles wide, seven miles long, and contains 130,000 acre-ft. of water. A dyke will be built across the eastern end, which will enlarge the storage capacity of the lake. The channel of the San Jacinto River, which feeds it, will be deepened and widened to carry additional drainage. The waters will be conveyed from the lake through flumes and a pressure pipe to a cliff over the Santa Ana River, and from there will be conducted to the ranch. A drop of 740 ft. will be obtained by so doing, and this, it is estimated, will produce 3,000 HP.

OGDEN, UTAH.—Engineers of the Utah Light & Ry. Co. are engaged preparing plans for the power plant to be built in Weber Canyon by the Harriman interests. Actual construction work will begin within a few weeks, and the plant will be completed and ready for use this fall. The plant will generate 3,000 HP., which will be distributed in Salt Lake and Ogden. A dam for the conservation of water will be built on the Weber River, above Devil's Gate. The dam will be sufficiently large to feed the pipe line. The power-house will be built about two miles from Devil's Gate and on the north side of the Weber River. The pipe line will pass under the Union Pacific bridge at Devil's Gate, and will be carried with a gradual fall to the power-house. The cost of the plant and its construction will be about $200,000. Joseph S. Wells, Salt Lake City, is Gen. Mgr.; O. A. Honnold, Salt Lake City, Utah, is Electrical Engr.

BRIDGES.

SOUTHBRIDGE, MASS.—The BLANCHARD BROS. CO., of Uxbridge, Mass., were awarded the contract on July 1 by the Selectmen for constructing the bridges over the Quinnebaug River at Mill and River Sts., at $14,000.

HARTFORD, CONN.—Bids for the repair of the boulevard bridge over Park River at Forest St. were received by the Board of Contract and Supply on July 6, as follows: Peter Taylor, A. W. Byrne, Smith & Lee Champs and Thomas Malcolm. A. W. Byrne was the lowest bidder. The bids were referred to the City Engineer for computation.

BU... N. Y.—The Lake Shore & Michigan Southern Ry. Co. has rejected bids for construction of three bridges and will do the work by day labor, material to be furnished by the purchasing agent. The bridges are at Athol Springs, N. Y., 1,560 yds.; ... te; North Evans, N. Y., 850 yds., ... rving, N. Y., 900 yds., concrete; ... be 4-track, with concrete abut... and steel girders. B. R. Leffler, Chief Engr. Cleveland, Ohio, is Engr. Bridges.

J. ... Buff... ...yer & Son, Ellicott Square Bldg., ... the lowest bidders, at $6,384, for the substructure for the River St. ... over Slip No. 1. Francis G. War... ...ngr. Pub. Wks.

NE... N. J.—Bids for the construction of a ...footbridge over the Morris Canal at S... ...e, were opened on June 30 by the Essex ... ...ty Park Commission. The contract ... awarded to the A. E. SANFORD CO., ...rsey City, N. J., at $7,485. There were ... ...bids received. The lowest was that of F... ...Willetts, at $5,629. He received permi... ...to withdraw his bid, because he had ... ...a mistake in his figures. Two other ... ...posals were thrown out because of info... ...ces.

BR... ...ORD, PA.—The Bradford County Com... ...ners have awarded the contract for repair... ...and repairing 14 iron and steel bridg... ...J. M. WHITLEY, 20 Lormore St., Elmi... ...Y.

SU... ...RTOWN, PA.—Bids are asked by James ... Norris, County Controller, Luzerne County ... until 2 p. m., July 13, for constructing a ...stone retaining wall at the westerly approa... ...to the county bridge between Shavertown and Trucksville, in Kingston Township.

WA... ...INGTONVILLE, PA.—The contracts for constructing bridges at Washingtonville and Strawberry Ridge have been awarded by the County Commissioners to the NELSON MEREDITH CO.

WEST CHESTER, PA.—Bids are asked by the County Commissioners until noon, July 15, for the construction of a stone bridge in West Pikeland Township. William Stevens is Chn. Comrs.

*PHILADELPHIA, PA.—Bids are asked by the Department of Public Works until noon, July 24, for the construction of bridges under Schedule A. George R. Stearns is Dir. Pub. Wks.

EASTON, MD.—The W. W. TUNIS & BRO. LUMBER CO., Tunis Mills, Md., have been awarded the contract at $4,880 for rebuilding the Huckahoe bridge. The structure is to be of wood.

WASHINGTON, D. C.—Bids were opened on June 24 by Lieut. E. J. Dent, Corps Engrs., U. S. A., Washington, D. C., for furnishing material for constructing an inlet gate and bridge at the tidal reservoir. Contracts have been recommended for award as follows: To National Mortar Co., of Washington, for 7,000 bbls. + 1,400 bbls. Portland cement, Old Dominion brand, at $1.475 per bbl. with 7½ cts. for serviceable sacks and 5.5 cts. for repairable sacks returned; to L. E. Smoot, of Washington, for 3,800 cu. yds. + 750 cu. yds. 2-in. broken stone or gravel, 65 cts. per cu. yd.; same contractor, 3,000 + 600 cu. yds. sand, 40 cts.; to Potomac Granite Co., Washington, for 1,200 cu. yds. + 250 cu. yds. broken stone, $1.34; to J. B. Kendall, Washington, D. C., for 74,000 lbs. + 10 per cent. reinforcing steel, 1.72 cts.

NORFOLK, VA.—The contract for the construction of a concrete bridge over Newton Creek, connecting Holt St. and Lovitt Ave. has been awarded by the Board of control to J. W. DAVIS, of Newport News, Va., at $6,700, for an all concrete structure. The specifications called for bids for an all concrete bridge and concrete and iron rail bridge. As there was only $300 difference between the all concrete and iron railing bridge, the all concrete bridge was accepted. Other bidders were: Alsop & Pierce, Newport News, all concrete, $7,250; concrete and iron rail, $7,200; W. Richardson and I. E. Blumgardt, Norfolk, Va., all concrete, $7,921; concrete and iron rail, $7,734; L. Lawson, Norfolk, all concrete, $7,600; concrete and iron rail, $7,500; John Monk, Norfolk, all concrete, $7,898; concrete and iron rail, $7,865; Hopkins-Burnett Co., Baltimore, Md., all concrete, $9,800; concrete and iron rail, $8,960; Baltimore Ferro Concrete Co., Baltimore, Md., all concrete, $7,979; concrete and rail, $7,681. W. T. Brooke is City Engr.

NASHVILLE, TENN.—The item in the issue of June 25 stating that two bridges are to be constructed over the Cumberland River here, is incorrect. The bridges are in course of construction.

MIAMISBURG, OHIO.—The County Commissioners on June 30 awarded the contract for constructing the canal bridge at Linden Ave., Miamisburg, to the SCHERZER ROLLING LIFT BRIDGE CO., Monadnock Bldg., Chicago, Ill., at $8,424. The bridge is what is known as the bascule type.

UPPER SANDUSKY, OHIO.—Bids are asked by J. N. Traxler, County Audr., until noon, July 28, for constructing a stone abutment and replanking the Johnson bridge at McCutchenville, Tymochtee Township.

CLAY, OHIO.—The HANCOCK IRON & STEEL CO. was awarded the contract on June 27 for the construction of the Elder bridge in Delaware Township.

NEWARK, OHIO.—Bids are asked by the County Commissioners until 1.30 p. m., July 13, for the construction of several bridges and culverts in Licking County.

CLEVELAND, OHIO.—We are officially advised that the contract for the construction of a concrete arch in Parma Township was awarded on July 1 by the County Commissioners to J. BUHL, of Brooklyn, Ohio, at $3,045.

SAGINAW, MICH. — The CENTRAL STATES BRIDGE CO. was awarded the contract on June 29 by the County Road Commission for the construction of the Gratiot State road bridge at $62,000. A girder bridge will be built.

NEW PHILADELPHIA, OHIO.—Bids are asked until 1 p. m., July 25, by A. V. Donahey, County Audr., for the construction of several culverts and retaining walls.

MUSKEGON, MICH.—The Bridge Committee of the Board of Supervisors on June 30 awarded the contract for constructing the Mona Lake bridge to replace the floating bridge, the Maple Island bridge and the Muskegon River swing bridge to the WHEATON IRON & CONSTRUCTION CO., at about $41,000.

*CHICAGO, ILL.—Bids are asked by the Board of Trustees of the Sanitary District of Chicago until noon, July 29, for the equipment of the Ninth St. and 16th St. bridges. Robert R. McCormick is Pres. of Bd.

WHEELING, ILL.—Bids are asked until July 10 by H. L. Emerson, Consulting Engr., Washington St., Chicago, Ill., for a reinforced-concrete highway bridge in Wheeling Township.

MILWAUKEE, WIS.—We are officially advised that bids were received as follows on July 6 by Charles G. Poetsch, City Engr., for constructing the Highland Boulevard viaduct: Cullen-Friestedt Co., Chicago, Ill., $73,460; B. E. SIVYER, Milwaukee, $57,773 (awarded contract); Sterling Engineering & Construction Co., Milwaukee, $59,358; D. B. Danielson, Milwaukee, Wis., $69,717; Austin Construction Co., Milwaukee, $61,997; John A. Dahlman, Milwaukee, $64,900; Schillinger Brothers Co., Chicago, $59,769.

The following bids were received for constructing Section 4 of the Washington Ave. viaduct: H. C. Fuldner, Milwaukee, $7,320; B. E. Sivyer, Milwaukee, $7,945; John P. Dean, Milwaukee, $7,900; A. Monsted Co., Milwaukee, $7,993; L. A. PETTIBONE, Fond du Lac, Wis., $6,026 (awarded contract); John A. Dahlman, Milwaukee, $7,300.

JOSEPH SKOBIS, Milwaukee, has been awarded the contract for constructing the side approach to the First Ave. viaduct, at $25,194. Other bidders were: Modern Steel Structural Co., Waukesha, Wis., $30,972; Wisconsin Bridge & Iron Co., North Milwaukee, Wis., $25,570; Worden-Allen Co., Milwaukee, Wis., $25,721; Stroebel Steel Construction Co., Chicago, Ill., $33,900; American Bridge Co., Milwaukee, $27,628; Adolph F. Bues, C. H. Starke, D. & D. Co., Milwaukee, $27,652; L. A. Pettibone, Fond du Lac, Wis., $25,733; Raulf-Leuis Construction Co., Milwaukee, $30,830; Milwaukee Bridge Co., Milwaukee, $25,225.

CLINTON, IOWA.—Bids are asked by the City Council until 8 p. m., July 14, for the construction of a concrete culvert. W. E. Hayes is City Clk.

STILLWATER, MINN.—Bids are asked by the City Council until 7.30 p. m., July 21, for the construction of a stone and a concrete culvert at the Everett St. crossing of the McKusick ravine.

CROOKSTON, MINN.—The MINNEAPOLIS BRIDGE & IRON CO. was awarded the contract for four steel bridges in Polk County on June 23 by the County Commissioners at about $7,000. The bridges are located at Climax, between Keystone and Tabor Townships between Farley and Sandsville and in the town of Garden, near Fertile.

KANSAS CITY, MO.—The County Court awarded on June 25 the contract for the construction of a reinforced-concrete arch and masonry bridge over Heart Grove Creek on the Holmes Park road to the MIDLAND BRIDGE CO., at $7,047.

HOUSTON, TEX.—Bids are asked until noon, July 14, by John B. Ashe, County Audr., for the construction of a bridge over Southmayd bayou on the Cypress and Barker road, and other bridges in the county.

GUTHRIE, OKLA.—The city voted $35,000 of bonds for the construction of a viaduct on Noble Ave.

PAWNEE, OKLA.—The Commissioners of Pawnee and Osage Counties will have constructed jointly a steel bridge over the Arkansas River, which divides the two counties. The structure will cost about $20,000.

SACRAMENTO, CAL.—The following bids were opened on June 24 by the Board of Supervisors for the bridge over the American River at Mormon Island to be constructed for Sacramento and El Dorado Counties: Pacific Construction Co., 17 Spear St., San Francisco, Cal., $23,897; Canton Bridge & Iron Co., Canton, Ohio, $27,800; C. G. Shelly, $22,400; Clark & Henery Construction Co., $21,774; San Francisco Bridge Co., 220 Market St., San Francisco, $24,600; Cotton Bros. & Co., Bacon Bldg., Oakland, Cal., $27,600; Burrell Bridge Co., $28,700; Hyde & Hargis Co., $22,220; Darby Laydan, 219 Steuart St., San Francisco, $20,995; M. B. White, $20,884; C. W. Swain, $24,919; Healy-Tibbetts Construction Co., 268 Market St., San Francisco, $22,447; West Bridge Co., $21,750; American Construction Co., 896 Eddy St., San Francisco, $23,248; Jenkins & Wells, $21,775; Murray-Elwell Co., $22,850; Continental Fireproof Co., $29,958. An order was made returning all the checks except those of the lowest bidders, who were Darby Laydon, M. B. White and the West Bridge Co.

BUILDINGS.

(denotes that this work is advertised in Engineering News.)*

WATERTOWN, MASS.—Bids are asked until 3 p. m., July 20, by the Commanding Officer, Watertown Arsenal, for the erection of one set of quarters for two noncommissioned officers at Watertown Arsenal.

DORCHESTER, MASS.—Plans have been prepared for a storage warehouse and stores to be erected by Thomas G. Buckley, 9 Magnolia St., Roxbury, Mass., at 692 Dudley St., Dorchester, adjoining the tracks of the Midland Division of the New York, New Haven & Hartford R. R. The building will be five stories high, constructed of concrete, and will contain four stores, two offices and apartments for storage. It will cover the whole lot, which has a frontage of 45 ft. and a depth of 125 ft. It will adjoin the proposed station at Dudley St.

BOSTON, MASS.—An 11-story mercantile and office building is to be erected on the corner of Washington St. and Temple Pl., representing a total investment of $2,500,000. The building is to be financed by George A. Carpenter, 373 Washington St., and built from the plans of Arthur H. Bowditch, Arch., 7 Water St. It will be completed by June 1, 1909. It will have a frontage of about 96 ft. on Washington St. and of 92 on Temple Pl. On each floor the area will be about 8,700 sq. ft. The first four floors are to be arranged for retail business. It will contain five plunger elevators.

NEW HAVEN, CONN.—R. H. Robertson & Son, Archs., 160 Fifth Ave., New York, N. Y., have let general contract to the H. WALES LINES CO., Meriden, Conn., for a 5-story dormitory building for Yale University, New Haven. Cost, $125,000.

HARTFORD, CONN.—Bids are asked until 11 a. m., July 13, by the Board of Contract and Supply, for repairing the City Hall. James P. Berry is Secy. Bd.; Frederick L. Ford is City Engr.

CORNING, N. Y.—Plans will be prepared by Otis Dockstader, Arch., 520 Robinson Bldg., Elmira, N. Y., for a 2-story and basement high school building for the Board of Education, Corning. The structure will cost $50,000.

NEW YORK, N. Y.—We are officially advised that the FOUNDATION CO. has been awarded the contract for the construction of the foundations for the new building of the Farmers' Loan & Trust Co. This building extended through from Beaver St. to Exchange Pl. and adjoins the old building of that company. The foundations consist of 18 concrete piers all carried down to bed rock, using pneumatic caisson method.

Ernest Greene, Arch., 5 Beekman St., has completed plans for a 10-story club building for the New York Press Club. Estimated cost, $100,000.

NEW YORK, N. Y.—We are advised by Frederick C. Zobel, Arch., 114 East 28th St., that estimates will be taken probably in about two weeks for an 8-story brick and stone building, 47.4 × 90 ft., for stores and offices, to be erected at 31 East 27th St. for the Felt Construction Co., 117 West 26th St. Cost, $80,000.

Neville & Bagge, Archs., 217 West 125th St., advise us that estimates will be taken at once for two 5-story brick and stone tenements to be built for William C. Oesting, 889 St. Nicholas Ave., at $72,000. The building will be the same in every particular and each will measure 52.6 × 87.4 ft. They will be erected on the south side of 180th St., about 150 ft. west of Broadway.

NEW YORK, N. Y.—Bids are asked until 11 a. m., July 20, by C. B. J. Snyder, Supt. of School Bldgs., Dept. of Education, for alterations, repairs, metal ceilings, etc., in Public Schools Nos. 1, 18 and 38, Boro. of the Bronx; for metal ceilings for Public Schools Nos. 13, 71, 75 and 180, Boro. of Manhattan; for repairs to roof, etc., at Public School No. 20, Rivington, Forsyth and Eldridge Sts., Boro. of Manhattan; for new fireproof main stairs at Public Schools Nos. 28, 32, 35, 48, 53, 54, 57, 59, 70, 72, 73, 74, 75, 76, 78, 80, 112, 113, 125, 126, 130, 161, 180, Boro. of Manhattan; for terrazzo floors at Wadleigh High School, 114th and 115th Sts., near Seventh Ave., Boro. of Manhattan; for erecting iron gates, railings and bronze tablets at De Witt Clinton High School, Tenth Ave., 58th and 59th Sts., Boro. of Manhattan; for alterations and repairs, etc., to Public School No. 14, Chicago Ave. and Grove St., Elmhurst, Boro. of Queens; for heating repairs, etc., of Public Schools Nos. 27, 34, 45, 52 and Jamaica Training School, Boro. of Queens; for fire protection, etc., at Public Schools Nos. 3, 9, 15, 16, 23 (N. B.), 31, 35 (N. B.), 36, 40, 107, Boro. of Brooklyn; for alterations, repairs, etc., at Public Schools Nos. 60, 62, 146, Boro. of Brooklyn.

NEW YORK, N. Y.—We are advised by Parish & Schroeder, Archs., 12 West 31st St., that the following contracts have been let for the Domestic Science building, Teachers' College, Broadway and 120th St., as follows: General contract, EDWARD CORNING CO., 100 William St.; elevators, OTIS ELEVATOR CO., 17 Battery Pl.; plumbing, J. F. McKEON & BROS., 882 Lexington Ave. The building will be built of brick and red sandstone, will be 60 × 150 ft., five stories high, and will cost $350,000.

POUGHKEEPSIE, N. Y.—Jackson & Rosencrans, Archs., 31 Union Sq., New York, have let general contract to T. REILLY CO., 103 Park Ave., New York City, for a 3-story building for the Y. M. C. A., L. H. Shaw, Secy., Poughkeepsie. Cost, $150,000.

BUFFALO, N. Y.—In about 30 days invitations for competitive plans will be issued for construction of the proposed Technical High School to cost $300,000. Francis G. Ward is Comr. of Public Works.

BUFFALO, N. Y.—Dr. V. Mott Pierce, of the World's Medical Dispensary Association, 663 Main St., will build a fireproof business block on Main St., north of Chippewa St., at a cost of about $150,000.

*BAYONNE, N. J.—Bids are asked by the Board of Education, Ave. C. and 26th St., until 8.30 p. m., July 16, for furnishing fire escapes for several schools in Bayonne. W. J. Tomlin is Secy.

WOODBURY, N. J.—The bids received on July 2 by the Board of Education for erecting the proposed high school building numbered 24. The lowest bid was submitted by Joseph Steelman, of Philadelphia, Pa., at $53,473.

PHILADELPHIA, PA.—Bids are asked until 11 a. m., July 20, by Col. F. L. Denny, Q. M., U. S. Marine Corps, Washington, D. C., for the construction of an addition to the Philadelphia Depot, 1100 South Broad St., Philadelphia. Rankin, Kellogg & Crane, 1012 Walnut St., Philadelphia, are Archs.

WILKES-BARRE, PA.—We are officially advised that the contract for constructing the Luzerne County court-house, Wilkes-Barre, for which bids were received on June 25, was awarded to the CARLUCCI STONE CO., 60 Ward Ave., Scranton, Pa., at $71,800. McCormick & French, Laning Bldg., Wilkes-Barre, are Archs.

LEAGUE ISLAND (Philadelphia post-office), PA.—The following bids were opened by the Quartermaster, U. S. Marine Corps, Washington, D. C., on June 25 for constructing three sets of officers' quarters at the Navy Yard, League Island, Pa.: Appleton & Burwell, 1204 Chancellor St., Philadelphia, Pa., $40,791, 8 months; Edward Fay & Son, 2966 Richmond St., Philadelphia, Pa., $40,475; Horace B. Bealle Co., Philadelphia, Pa., $42,537, 8 months; George A. Glenn & Co., 930 North Eighth St., Philadelphia, Pa., $39,300, 8 months; William Provost, Jr., Philadelphia, Pa., $43,311, 9 months; Roydhouse-Arey Co., Delaware & Van Kirk Sts., Philadelphia, Pa., $44,985, 100 days; Lynch Bros., James & Pratt Sts., Philadelphia, Pa., $41,184, 8 months; Cramp & Co., Commonwealth Bldg., Philadelphia, Pa., $42,155, 8 months; R. M. Peterson, 5250 Wakefield St., Germantown, Philadelphia, Pa., $47,275, 9 months; B. Ketcham & Son, Philadelphia, Pa., $639,642, 150 days; F. T. Maguire, 1710 Sansom St., Philadelphia, Pa., $42,261; Charles McCaul Co., Tenth and Sansom Sts., Philadelphia, Pa., $44,538; Henry E. Eaton, Philadelphia, Pa., $47,897; A. Raymond Raff, 1635 Thompson St., Philadelphia, Pa., $43,300; James G. Doak & Co., 1420 Chestnut St., Philadelphia, Pa., $44,500; Herbert Havens, Girard Bldg., Philadelphia, Pa., $42,592.

*MEADVILLE, PA.—The following bids were received on June 30 by James Knox Taylor, Supervy. Arch., Treasury Dept., Washington, D. C., for constructing a U. S. post-office at Meadville: William I. Gray & Sons, 30th St., below Walnut St., Philadelphia, $66,965; A. E. Badgley, Binghamton, N. Y., $66,800; W. H. Fissell & Co., 1133 Broadway, New York, $70,500; Constable Bros. Co., Erie, Pa., $67,482; M. P. Wells, Philadelphia, $58,945; Henry Shenk Co., Erie, $62,536; John G. Unkefer & Co., Minerva, Ohio, $61,800; W. R. Compton Realty & Building Co., Elmira, N. Y., $63,645.

MORGANZA, PA.—Bids are asked until noon, July 11, by Thorston E. Billquist, Arch., 341 Sixth Ave., Pittsburg, Pa., for several proposed buildings for the Pennsylvania Reform School here. The proposed buildings include two dormitory buildings, modern gymnasium and an addition to the power-house. Edward McDonald is Chn. Bldg. Com. The new buildings will be designed to replace the present buildings, and others will be designed later in the summer, making an entirely new group. It is estimated that the proposed improvements will cost $200,000.

GETTYSBURG, PA.—The Board of Trustees of Gettysburg College announces a gift of $100,000 from John E. Firch, Oakland, Cal., to be used for erecting a science building. Plans will be prepared and bids will be received in the fall.

BALTIMORE, MD.—Bids are asked by the Board of Award until July 15 for constructing a jail for the city of Baltimore. Theodore W. Pietsch, American Bldg., Baltimore, is Arch.

WASHINGTON, D. C.—A contract has been awarded to the GEORGE A. FULLER CO., Munsey Bldg., to construct a house for Mrs. S. R. Hitt, at the southeast corner of New Hampshire Ave. and Dupont Circle. Plans for the house have been prepared by John Russell Pope, 1133 Broadway, New York. The building will be of English design and constructed of limestone. The cost of the house is estimated at $150,000.

The Church of Immaculate Conception, Eighth and N Sts., N. W., has awarded contract to J. M. DUNN, 1324 Fifth St., N. W., Washington, to erect school and assembly hall, three stories high. The main hall will be amphitheater style, seating 600 persons. Cost, $50,000. Stanley Simmons, 931 F St., N. W., Washington, is Arch.

AUGUSTA, GA.—Bids are asked until July 28 by William N. Dunbar, Mayor, for erecting the proposed city hall. The building will be two stories high, 94 × 184 ft., of brick construction with stone trimmings. Cost, about $150,000. L. F. Goodrich, 115 Eighth St., Augusta, is Arch.

*RIVERTON, ALA.—Bids are asked until 11 a. m., Aug. 6, by Maj. William T. Harts, Corps Engrs., U. S. A., Nashville, Tenn., for building two brick dwellings and one brick storehouse at Colbert Shoals Canal lock, near Riverton, Ala.

KNOXVILLE, TENN.—Bids are asked until July 21, for erection of a banking building here for the City National Bank. Mowbray & Uffinger, 92 Liberty St., New York, N. Y., are Archs.

TOLEDO, OHIO.—Bids are asked by the Board of Education of Washington Township, Lucas County, until noon, July 24, for erecting a school building. Bacon & Hunter, Spitzer Bldg., Toledo, are Archs.; P. J. Wright, 169 Lewis Ave., is Clerk of Bd.

WARRENSVILLE, OHIO.—The lowest bid for constructing a 2-story correction building on the Cleveland city farm at Warrensville, was submitted by the C. H. Fath & Son Construction Co., 516 Electric St., Cleveland, at $115,714.

MOUNT VERNON, OHIO.—We are officially advised that the State Tuberculosis Commission, Dr. C. O. Probst, Secy., has let contract to R. H. EVANS & CO., Columbus Savings & Trust Bldg., Columbus, at $300,000, for the construction of the sanitarium, at Mount Vernon. Noted on June 11.

COLUMBUS GROVE, OHIO.—Howard, Inscho & Merriam, Archs., Columbus, are preparing plans for a 2-story, 14-room school building for the Board of Education, Columbus Grove. Estimated cost, $40,000.

INDIANAPOLIS, IND.—Plans have been ordered for a new city hall. Bids will be invited as soon as plans are completed. Joseph T. Elliott is Chn. Bd. of Public Works.

*BEDFORD, IND.—Bids are asked by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., until 3 p. m., Aug. 11, for the construction (including plumbing, gas piping, heating apparatus, electric conduits and wiring) for the U. S. post-office building at Bedford.

NEGAUNEE, MICH.—J. D. Chubb, Arch., 112 Clark St., Chicago, has prepared plans for a high school building for the Board of Education, Negaunee, to cost $80,000.

OAK PARK, ILL.—Plans have been prepared by Patton & Miller, Archs., Hartford Bldg., Chicago, Ill., for an additional wing to the Oak Park and River Forest Township high school at Oak Park. It is estimated that the building will cost $50,000.

STURGEON BAY, WIS.—Plans are being prepared by Foeller, Benton & Schober, Paul Fox Bldg., Green Bay, Wis., for a school building for Sturgeon Bay. Cost, $45,000. The proposed building will replace the structure which was destroyed by fire.

RHINELANDER, WIS.—Bids are asked until July 20 for constructing a 3-story court-house, to cost $100,000. It will be of stone fireproof construction, 120 × 95 ft. C. H. Tegen, Métropolitan Bldg., Manitowoc, Wis., is Arch.; Arthur Taylor is Chn. Board Comrs.

IOWA CITY, IOWA.—Bids are asked until July 23 by the Board of Regents of the State University of Iowa for a Law Building, to be four stories high, 62 × 133 ft., and to cost $100,000. The work will be let in one contract, except heating, lighting and plumbing, which will be done by the University. George E. McLean is Pres. Proudfoot & Bird, Crocker Bldg., Des Moines, Iowa, are Archs.

MINNEAPOLIS, MINN.—Simon Kruse, of Chicago, Ill., has begun excavating for a building to be erected immediately on Seventh St., to be twelve stories high, 128 × 120 ft., and to cost $750,000.

ST. PAUL, MINN.—Plans will be received by O. Savard, Secy. Board of School Inspectors, until noon, Sept. 1, for a fireproof mechanic arts high school building. The winner of the first prize will be commissioned to design and supervise the erection of proposed building. Dr. Christian Fry is Pres.

ST. PAUL, MINN.—John H. Wheeler, New York Life Bldg., advises us that he has prepared plans for a 4-story pressed brick and cut stone dormitory, 60 × 96 ft., for St. Agatha's Conservatory, Cedar and Exchange Sts. It will have steam heating, electric lighting and plumbing, slate roof, marble and tiled work. There will be a 3-story pressed brick and cut stone refectory and chapel. It will have a seating capacity of 250, steam heating and electric lighting, dining room, kitchen, terrazzo, altar and refrigerator. Cost, complete, $65,000. The GEORGE J. GRANT CONSTRUCTION CO., 61 East Ninth St., St. Paul, has contract for basement work. The balance of the work will be let the latter part of this month.

IOLA, KAN.—Bids were received as follows July 7 at the office of James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., for the construction of a post-office at Iola, Kan.: Frank H. Latimer, Kansas City, Mo., $45,832; J. A. Daly, Nevada, Mo., $41,575; Wurster Construction Co., Wichita, Kan., $47,048; Fred. Dieter, Joplin, Mo., $42,820; Carl A. Nilson, Kansas City, Mo., $44,662.

OMAHA, NEB.—John Latenser, Arch., Bee Bldg., has been selected to prepare plans for a court-house to be built here for Douglas County. Cost, $1,000,000.

GREAT FALLS, MONT.—The plans for the proposed Federal building for this city will be completed for bidders in the fall. The building is to cost $225,000. E. H. Cooney has been appointed Custodian.

ST. CHARLES, MO.—The contract for construction of a post-office building at St. Charles, bids for which were received on June 12, has been let by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., to the KELLERMAN CONTRACTING CO., Roe Bldg., St. Louis, Mo., at $43,657. Noted on June 18.

ST. LOUIS, MO.—E. Ross Chamblin, Arch., 620 Chestnut St., St. Louis, is preparing plans for a 12-story storage warehouse for William O. Langan, to cost $150,000.

Plans have been prepared by Cass Gilbert, 11 East 24th St., New York, N. Y., for a 1-story library building for the Public Library, J. F. Lee, Secy., St. Louis. Estimated cost, $1,200,000.

The Harold Realty Co. will erect six apartment houses at the corner of Page and Semple Aves. The structures, with the site, will cost $125,000. Five of the houses will contain three apartments of five and six rooms and the other will have six apartments of the same size. The buildings will occupy a lot 166 × 150 ft. and will be three stories high and constructed of brick, marble and granite. Edward F. Nolte, 620 Chestnut St., is Arch.

GREENVILLE, TEX.—Bids for the construction of the U. S. post-office at Greenville, Tex., were received on June 25 by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., as follows: Shepherd Bros., Greenville, Tex., $50,870, time, July 1, 1909; T. A. Lindsay, Commerce, Tex., $53,445, July 31, 1909; Campbell & Owen, Paris, Tex., $61,333, one year; John Baden, Fort Worth, Tex., $50,760, July 31, 1909; Lewis R. Wright, Dallas, Tex., $59,900, July 31, 1909; John I. Porter & Co., Tyler, Tex., $61,157; Fell & Ainsworth, Waco, Tex., $50,000, July 31, 1909.

STILLWATER, OKLA.—We are officially advised that the Board of Regents of the Oklahoma Agricultural and Mechanical College, Stillwater, will invite architects to submit plans for a boys' dormitory to cost $25,000 and a woman's building to cost $60,000. The Board will meet Aug. 12 to examine the plans submitted. R. E. Chandler, Stillwater, will furnish preliminary plans and further information.

PUEBLO, COLO.—Albert R. Ross, 542 Fifth Ave., New York, N. Y., and G. W. Roe, Grand Opera House Block, Associate Archs., Pueblo, have completed plans for the 3-story court-house, to be built at Pueblo, for the Board of Pueblo County Commissioners. A. T. Stewart is Chn. Bldg. Com. The building will cost $400,000.

SALIDA, COLO.—F. E. GIMLET has secured contract to build a hospital for Dr. F. N. Cochems at about $40,000.

SEATTLE, WASH.—Work will be started within three weeks on the proposed 11-story building which is to be erected by the Metropolitan Building Co. Estimated cost, $500,000. Howells & Stokes, 100 William St., New York, N. Y., are Archs.

Bids are asked by the Board of School Directors until July 15 for construction of the proposed Queen Ann high school. James Stephen, New York Block, is Arch. Estimated cost, $200,000.

SPOKANE, WASH.—Bids are asked by R. C. Sweatt, Arch., for constructing a 3-story brick and stone building, 100 × 100 ft., for the Home for Friendless Children. The cost will be about $50,000.

LOS ANGELES, CAL.—The contract for plumbing and gas-piping, etc., in the new post-office at Los Angeles, Cal., has been awarded to THOMAS HAVERTY CO., 517 South Los Angeles St., Los Angeles, Cal., at $42,152. The OTIS ELEVATOR CO., 218 East Fourth St., Los Angeles, and 17 Battery Pl., New York, has contract for elevator plant, at $14,955.

SAN FRANCISCO, CAL.—The Board of Directors of the Union Trust Co. has approved designs of Clinton Day, Arch., Union Trust Bldg., for the bank building of the company, to be erected at the corner of Market, O'Farrell St. and Grant Ave. The building will be about 70 ft. high, with one story and galleries. The front of the building, which will be curved, will be 80 ft. and the depth on Grant Ave., 120 ft.

The Y. M. C. A. will erect a 9-story building at Golden Gate Ave. and Leavenworth St. It will contain a gymnasium, swimming tank and apartments. The structure will cost about $500,000. Henry J. McCoy is Secy.

Mrs. Emma Rose has employed Reid Bros., Archs., Claus Spreckels Bldg., to prepare plans for an office building to be built on Sutter St., between Kearny St. and Grant Ave., at a cost of $500,000.

We are officially advised that the contract to erect a 2½-story building, 80 × 80 ft., for the Metropolitan Life Insurance Co. has been let to GEORGE A. FULLER CO., Monadnock Bldg., San Francisco, and Flatiron Bldg., New York, at $180,000. The building will be Class A, of steel and concrete construction, and will be erected at Pine and Stockton Sts. N. Le Brun & Sons are Archs.

PROVO, UTAH.—The contract for construction of a post-office building at Provo, bids for which were received on June 23, has been let by James Knox Taylor, Superv. Arch., Treasury Dept., Washington, D. C., to TOM LOVELL & SONS, Denton, Tex., at $52,831. Noted on June 25.

WINNIPEG, MAN.—Smith & Bruce, Archs., Winnipeg, advise us that Sanitarium Board is considering the following plans for a sanitarium to be built by the Provincial Government: Village plan, block plan, terrace plan and corridor plan. The building will be fireproof, three or four stories high. The contract will be let within a few weeks. Hon. Robert Rogers is Minister of Public Works, Winnipeg.

Bids will be received by W. W. Blair, Arch., Northern Bank Bldg., until July 11 for the erection of a 5-story and basement brick and stone apartment block. Estimated cost, $150,000.

MOOSE JAW, SASK.—Bids are asked until July 15 by H. Jagger, Secy.-Treas. High School Bd., for erecting the Collegiate Building at Moose Jaw. John D. Atcheson, Bank of Toronto Bldg., Winnipeg, Man., is Arch.

REGINA, SASK.—The contract for the erection of the Saskatchewan Parliament buildings has been awarded to PETER LYALL & SONS, 88 King St., Montreal, Que., at $1,424,120. Work will be commenced at once.

VANCOUVER, B. C.—Bids are asked until noon, July 15, by the Commissioner of Public Works for erecting a Normal School at Vancouver. Pearce & Hope, Vancouver, are Archs.; F. C. Gamble, is Engr. Pub. Works.

WATER SUPPLY—IRRIGATION.

(denotes that this work is advertised in Engineering News.)*

DOVER, N. H.—Bids for the construction of a filtration plant with a daily capacity of 2,000,000 gallons, the city to furnish c.-i. pipe, special castings and valves, and to construct the necessary buildings, were opened on June 30 by the Water Commissioners as follows: RYAN UNMACK CO., 134 Oliver St., New Haven, Conn., $22,000 (awarded contract); Charles N. Taylor, $22,950; Richmund F. Hudson, $23,800; Long & Little Co., $23,975; Bryne Contracting Co., $27,000; Coughlan & Sheils Co., $27,990; C. H. Holmes, $23,448; C. E. Trumbull Co., $30,388; Falvey & Kelley, $30,450; Hanscom Construction Co., $33,400; Abertham Construction Co., $37,516. William S. Johnson, 101 Tremont St., Boston, Mass., is Engr.-in-Charge.

ANDOVER, MASS.—The contract for constructing the reservoir here was awarded by the town on June 22 to D. LINAHAN & SONS, of Pride's Crossing, Mass., at $5,274.

NEW YORK, N. Y.—Bids are asked until 2 p. m., July 15, by John H. O'Brien, Comr. Water Supply, Gas and Electricity, for furnishing, delivering and installing one hand-operated traveling crane in the high pressure pumping station located at Gansevoort and West Sts., and furnishing, delivering and installing one hand-operated traveling crane in the high pressure pumping station located at Oliver and South Sts., Borough of Manhattan; for furnishing and delivering, erecting and connecting one pumping engine, with all its appliances, foundations and appurtenances complete and in place, at the Mt. Prospect pumping station, Underhill Ave. and Prospect Place, in the Borough of Brooklyn, together with the removal of certain designated old materials at the same station; for furnishing, putting in place and maintaining 160 gas regulators, from July 15, 1908, to Dec. 31, 1908, both inclusive.

EAST ORANGE, N. J.—Bids are asked until July 13 by the city for furnishing and erecting an engine complete on foundations furnished by city at the White Oak Ridge pumping station.

JAMESBURG, N. J.—Bids are asked until July 22 by the Board of Trustees of the New Jersey State Home for Boys, Jamesburg, for boring a well at the home.

*PITTSBURG, PA.—Westwater & Casey, of Columbus, Ohio, submitted the lowest bid on June 29 to the Public Works Department for the construction of filters, etc., in O'Hara Township for the city, at $640,000.

WASHINGTON, D. C.—The following bids were opened by the Commissionrs of the District of Columbia, on June 27, for furnishing curb and corporation cocks:

A. P. Smith Mfg. Co., Newark, N. J., ¾-in., corporation cocks, 57 cts.; 1-in., 92 cts.; 1¼-in., $1.30; 1½-in., $2; 2-in., $4; ¾-in. curb cocks for lead pipe, 87 cts.; 1-in., $1.30; ¼-in., $1.60; ¾-in. curb cock for iron pipe, 75 cts.; ¾-in., for iron and lead pipe, 75 cts.; 1-in., for iron pipe, $1.50; 1¼-in., for iron pipe, $1.60.

The Anderson Coupling Co., Hartford, Conn., ¾-in. corporation cock, 53 cts.; 1-in., 84 cts.; 1¼-in., $1.24; 1½-in., $1.03; 2-in., $4.10; ¾-in. curb cocks for lead pipe, 78 cts.; 1-in., $1.25; 1¼-in., $1.60; ¾-in. curb cocks for iron pipe, 65 cts.; ¾-in., for iron and lead pipe, 65 cts.; 1-in., for iron pipe, $1.03; 1¼-in., for iron pipe, $1.60.

Glauber Brass Mfg. Co., Cleveland, Ohio, ¾-in. corporation cock, 66 cts.; 1-in., $1.04; ¾-in. curb cocks for lead pipe, 96 cts.; 1-in., $1.39; ¾-in. curb cocks, for iron pipe, 89 cts.; ¾-in., for iron and lead pipe, 93 cts.; 1-in. curb cocks, for iron pipe, $1.16; 1¼-in., $1.87.

H. Mueller Mfg. Co., 254 Canal St., New York, ¾-in., corporation cock, 59.7 cts.; 1-in., 86.3 cts.; 1¼-in., $1.425; 1½-in., $2.286; 2-in. $4.248; ¾-in. curb cocks for lead pipe, 95.75 cts.; 1-in., $1.377; 1¼-in., $1.59 3-10 cts.; ¾-in., for lead pipe, 78 cts.; ¾-in., for lead and iron pipe, 78.75 cts.; 1-in., for iron pipe, $1.15; 1¼-in., $1.65.

*BURLINGTON, N. C.—Bide are asked by the Water and Sewer Commission until July 21, for building a system of water-works and sewers. Gilbert C. White, of Durham, N. C., is Engr.

FITZGERALD, GA.—The citizens on June 24 voted to issue bonds for $25,000 for the construction of water-works, $75,000 for sewers and $30,000 for schools.

BIRMINGHAM, ALA.—The American Water-Works & Guarantee Co. has engaged John W. Hill, First National Bank Bldg., Cincinnati, Ohio, as Consulting Engineer on the new Cahaba Dam to increase the water supply of Birmingham. The dam will be of masonry, cut stone, concrete and cyclopean rock, 60 ft. high by about 300 ft. long and will be founded on bed rock, and will be capable of storing when completed about 6,000,000,000 gallons of water.

CINCINNATI, OHIO.—Specifications for cleaning water mains are being prepared by the Superintendent of Water-Works.

KNOX, IND.—The city has decided to have constructed a water-works system to cost about $18,000. Plans and specifications are being prepared by George C. Morgan, Royal Insurance Bldg., Chicago, Ill. H. C. Wise is City Clk.

DETROIT, MICH.—The contract for furnishing about 172 tons of castings has been awarded to the RUSSELL WHEEL & FOUNDRY CO., of Detroit, at $2.57½ per 100 lbs. Bids were opened on June 23. B. F. Guiney is Secy. Bd. Water Comrs.

*GRAND RAPIDS, MICH.—The following are the bids received on June 25 for furnishing a 12,000,000-gallon pump by the Board of Public Works, the alternate bids submitted by the several firms as representing the technical differences from the specifications as submitted by the board: Bethlehem Steel Co., Keystone Bldg., Pittsburg, Pa., according to specifications, $114,100; alternate A, $132,300; alternate B, $110,400; Wisconsin Engine Co., according to specifications, $73,700; alternate A, $68,800; William Todd Co., Youngstown, Ohio, according to specifications, $72,000; alternate B, $69,150; Holly Mfg. Co., 118 Liberty St., New York, according to specifications, $89,700; Hooben Owens Renslaer Co. (four bids), $92,000, $95,000; $90,000, $93,000; Wilson-Snyder Mfg. Co., $65,000; R. D. Wood & Co., 400 Chestnut St., Philadelphia, Pa., $67,000; Platt Iron Works, Dayton, Ohio., $64,000; Allis-Chalmers Co., Milwaukee, Wis., according to specifications, $67,500; alternate A, $65,000.

*WEST BRANCH, MICH.—Bids are asked until noon, July 20, by the City Clerk for constructing complete a system of water-works. (Extension from July 8.) John H. Blomshield is Consulting Engr.

MILWAUKEE, WIS.—We are officially advised that the contract has been awarded by the city to EDWARD O'DONNEL, Milwaukee, for laying a 36-in. water main in the east division, at $2.07 per lin. ft. Other bidders were: Blake Bros., Milwaukee, $2.12; Hase & Welker, Milwaukee, $2.60; R. J. Hickey, Milwaukee, $2.17. Charles G. Poetsch is City Engr.

AMES, IOWA.—Bids are asked by the Mayor and City Council until July 15 for the construction of an extension to the water supply system. A. B. Maxwell is City Clk.; Thomas H. MacDonald is City Engr.

TEMPLETON, IOWA.—Bids are asked until July 20 by the city for the construction of water-works. M. J. Daeges is City Clk.

WABASSO, MINN.—Bids are asked until July 15 for constructing a steel water tower and tank. Estimated cost, $7,000. Roland, of Des Moines, Iowa, is Engr. C. W.

BUHL, MINN.—See under Light and Power Plants.

HUTCHINSTON, KAN.—The contract for laying about six miles of water mains has been awarded by the Water, Light & Gas Co. to B. F. EVANS, of Newton.

HOUSTON, TEX.—L. H. COLE, of San Antonio, Tex., has been awarded contract for the construction of a sewage pumping plant with air-compressor, at $7,...

LINDSAY, OKLA.—See under Light and Power Plants.

*NOWATA, OKLA.—Bids are asked by A. H Gillespie, City Recdr., until July ... for the purchase by the city of all material required to construct a municipal water-works system. The O'Neil Engineering Co., Dallas, Tex., are Engrs.-in-Charge.

HOLLY, COLO.—The town has under consideration the construction of a system of water-works, for which an issue of bonds has been voted. Burns & McDonnell Bldg., Kansas City, Mo., are Consulting Engrs.

SEATTLE, WASH.—The City Council has passed ordinances providing for the following street improvements: Eleventh Ave. N. E. and other streets, water mains, $5,645; Fourth Ave. North, $3,650; Highland Place and other streets, $6,500; East 55th St. and other streets, $5,275; Burke Ave. and other streets, $25,770. R. H. Thomson is City Engr.

BREMERTON, WASH.—Bids are asked until Aug. 4 at the Bureau of Supplies and Accounts, Navy Dept., Washington, D. C., for constructing a water supply system complete at the Naval Magazine, Puget Sound, Bremerton. Applications for proposals should refer to Schedule 14. E. B. Rogers is Paymaster Gen., U. S. N.

KLAMATH FALLS, ORE.—The contract has been awarded to JAMES W. JOHN, of Klamath Falls, for the construction of about 5½ miles of the South Branch Canal laterals, Klamath irrigation project, Oregon, at $3,930. This work is located about 15 miles southeast of Klamath Falls and involves the excavating and embanking of about 25,000 cu. yds. of material.

FALLON, NEV.—The town may improve the sewerage and water system, such improvements being under consideration.

RICHFIELD, UTAH.—Bids are asked by the State Board of Land Commissioners, City and County Bldg., Salt Lake City, Utah, until 10 a. m., July 15, for the construction of a canal 20 miles long, involving about 200,000 cu. yds. of earth work. Bids will be received for the whole work or for the work in sections. Plans and specifications may be examined at the office of Thomas C. Callister, Secy. Bd., or at the office of H. N. Hayes, Richfield.

MONTREAL, QUE.—Contracts for supplies have been awarded by the Water Committee as follows: JAMES ROBERTSON CO., lead pipe, $82 per ton; tin, 29 cts. lb.; pig iron, THOMAS ROBERTSON CO., $63.20 per ton; lumber, J. T. MERCHAND & CO., at prices varying according to grade; special castings, P. AMESSE, at $49.50 a ton; W. R. CUTHBERT, brass castings, 16¾ cts. a lb., and bronze, 16¾ cts. a lb.

TORONTO, ONT.—The citizens on June 27 voted to issue $750,000 of bonds for a water filtration plant. C. H. Rust is City Engr.

GUELPH, ONT.—The contract for constructing the water conduit here has been awarded to CORM & CO., of Windsor, Ont., at about $30,000.

WINNIPEG, MAN.—The Board of Control has recommended to the Council that the bid of the Allis, Chalmers & Bullock Co. be accepted for a pump, to cost about $14,000. C. J. Brown is City Clk.

SEWERAGE.

(denotes that this work is advertised in Engineering News.)*

*BOSTON, MASS.—Bids are asked by the Metropolitan Water and Sewerage Board, 1 Ashburton Pl., Boston, until 2.30 p. m., July 31, for constructing in earth and rock trench a 69-in. × 72-in. concrete sewer and a 72-in. × 48-in. brick and concrete sewer, Section 86 of the extension of the high level sewer, South Metropolitan System, in Washington St., Brighton, in accordance with the forms of contract and specifications to be furnished by the Board. Some particulars are estimated to be as follows: Length of 69-in. × 72-in. concrete sewer, 1,305 ft.; length of 72-in. × 48-in. brick and concrete sewer, 1,135 ft.; 300 cu. yds. of Portland brick masonry; 3,000 cu. yds. of concrete masonry in trench; 300 cu. yds. of rock excavation in trench. The invert of the sewer is from 8 ft. to 26 ft. below the street surfaces. Plans can be seen and specifications and forms of contract can be obtained at the above office. William M. Brown is Ch. Engr. Sewerage Wks. William N. Davenport is Secy. Bd.

WOONSOCKET, R. I.—Bids were opened on June 23 by the Board of Sewer Commissioners for furnishing the material necessary for constructing a filter bed for sewage disposal, about 250 × 135 ft. and 5 ft. deep. The contract was awarded to the GLOBE CONSTRUCTION CO., of Woonsocket. The work includes excavation.

*WATERLOO, N. Y.—We are officially advised that the following bids were received on July 1, by the village for furnishing the materials and constructing a system of sewers with sewage disposal plant for the village, the work covering about 14 miles of vitrified pipe, from 6 to 20 ins., with trenching for same 4 to 16 ft. deep, with manholes, flush tanks, river crossing and septic tank: Sewer system: Golden & Lasing, Troy, N. Y., $82,147; 200 days; Swift, Bonn

& Co., Syracuse, N. Y., $82,886; 100 days; A. B. Griswold, New Britain, Conn., $74,891; 275 days; Barker & Underwood, Philadelphia, $89,301; 300 days; A. C. Martin & Co., Seneca Falls, N. Y., $83,921; 150 days; [illegible]NETT & SHEPARD, Niagara Falls, N. Y., $56,738; 350 days (awarded contract); Honeoye Falls Construction Co., Honeoye Falls, N. Y., $126,621; 250 days; Samuel [illegible]O'Rourke & Co., South Norwalk, Conn., $[illegible]19; 150 days; Frank S. Tierney & Son, Niagara Falls, $66,911; 150 days; A. L. Williams, Binghamton, N. Y., $75,019; 300 days; [illegible] & Moynehan, Herkimer, N. Y., $82,414; [illegible]days. Disposal plant: Golden & Lasher, [illegible]15,397; 200 days; A. B. GRISWOLD, New Britain, Conn., $10,717; 60 days (amended contract); C. T. Hookway, Syracuse, N. Y., $12,856; 50 days; A. C. Martin & Co., $14,141; 150 days; H. M. Sherwood, Baldwinsville, N. Y., $17,277; 100 days; A. [illegible], $17,095; 300 days; Lewis & Moynihan, $17,612; 150 days; Morrison & Farrington, Syracuse, N. Y, are Engrs.

SYRACUSE, N. Y.—Plans and specifications for the improvement of Onondaga Creek, in connection with the proposed intercepting sewer, are on file at the office of Engineering News. Bids are asked until July 23.

*PLAINFIELD, N. J.—We are officially advised that J. H. SAMMIS, of Belleville, N. J., has been awarded the contract by the city for the construction of sanitary sewers here, at $69,[illegible]. There were five other bids submitted. Bids were opened on July 6. Andrew J. Gavett is City Surv.

*EAST RUTHERFORD, N. J.—The contract for constructing the sewer system here has been awarded by the borough to the VAUGHN CONSTRUCTION CO., of Stamford, N. Y., at about $100,000. Bids were opened on June 24.

RIVER EDGE, N. J.—Bids are asked until July 13 by the Mayor and Council of the Borough of Riverside, at the Boro. Hall, River Edge, for constructing a vitrified pipe storm water drain through Bridge St., including 520 ft. of 24-in. and 495 ft. of 18-in. pipe, manholes, catch basins and all appurtenances.

PERTH AMBOY, N. J.—HARDIMAN & DEDRICKSEN were awarded the contract on June 30 by the Board of Aldermen for extending the South First and South Second St. sewers.

ELIZABETH, N. J.—Matthew Wade, of Elizabeth, submitted the lowest bid on July 1 to the City Council for the construction of intercepting and lateral sewers at $136,282. Other bidders were: Gallo & Musso, Newark, N. J., $136,334; Harrison Construction Co., Harrison, N. J., $212,164; J. H. Gray Co., $177,005; William J. McLeod & Co., $194,901; A. M. Sanford Co., $201,887.

NEW CASTLE, PA.—The Select Council passed an ordinance on June 29 providing for the issue of $12,000 for a storm sewer.

DERRY, PA.—Bids are asked until 8 p. m., July 13, by the Borough for the construction of 43,900 ft. of sewers. J. M. Nicholson is Borough Clk. Robert G. Gill, Greensburg, Pa., is Engr.

PHILADELPHIA, PA.—Bids are asked until July 24, by the Department of Public Works for the construction of main sewers under Schedule B. George R. Stearns is Dir. Pub. Wks.

*BURLINGTON, N. C.—See under Water Supply—Irrigation.

FITZGERALD, GA.—See under Water Supply—Irrigation.

WOODSFIELD, OHIO.—Bids are asked until noon, July 11, by the Village Council for sewering, curbing, grading and paving with hard burned brick portions of Church or Washington Sts. George P. Dorr is Village Clk.

COLUMBUS, OHIO.—The Board of Public Service on June 26 awarded the contract to C. T. McCRACKEN & CO. for the construction of the Sullivant Ave. sanitary sewer at $35,197. Concrete construction will be used. Edward W. Hirsch is Secy Bd.

AKRON, OHIO.—Bids are asked by the Board of Public Service until noon, July 13, for the construction of a storm water sewer in Miami St., from Voris to South Sts. Charles H. Watters is Pres. Bd.

ANGOLA, IND.—We are officially advised that R. L. Sackett, Prof. Sanitary and Municipal Engineering, Purdue University, has been made consulting engineer here and is designing a complete system of sewerage including two disposal plants. Surveys are being made and bids will be asked about Aug. 15 to Sept. 1 on about $50,000 worth of contracts, including $12,000 worth of concrete work.

HAMMOND, IND.—Bids are asked until 10 a. m., July 10, by the Board of Public Work for the construction of a 2-ft. internal diameter, vitrified pipe sewer.

NEWCASTLE, IND.—D. C. MITCHELL, of Muncie, Ind., has been awarded the contract by the City Council for the construction of the Grand Ave. sewer at about $14,000.

FORT WAYNE, IND.—Bids are asked by the Board of Public Works until July 16 for the construction of a sewer in Morton St., Vermont St., and Crescent Ave. H. W. Beekelt is City Clk.

BUTLER, IND.—The contract for constructing four miles of sewers has been awarded to NEWMAN SEWER CONSTRUCTION CO., of Evansville, Ind., at $32,000. Bids were opened on June 29. Frank A. Brink is City Clk.

*MILAN, MICH.—Bids are asked by W. P. Gregory, Village Clk., until July 14 for the construction of a sewer about 3,700 ft. long of 24, 20 and 15-in. diameter.

TWO RIVERS, WIS.—Bids are asked until July 17, by the Board of Public Works for constructing sewers in portions of Monroe, Eleventh and Madison Sts., requiring 360 ft. of 12-in., 420 ft. of 10-in., 870 ft. of 8-in. and 96 ft. of 6-in. sewer pipe, three flush tanks, two manholes and four catch basins. William Luebke is Chn. Bd.

JANESVILLE, WIS.—Bids are asked at the office of the Street Assessment Committee until July 24 for the construction of sewers in sewer districts Nos. 15, 14, 12, 11, 6, 5, 4 and 3, and a main outlet sewer in sewer districts Nos. 2, 3 and 4. C. V. Kerch is City Engr.; S. B. Heddles is Chn. Com.

ST. LOUIS, MO.—Bids are asked by the Board of Public Improvements until noon, July 17, for the construction of sewers in the Harlem Creek sewer district No. 3. W. B. Dryden is Secy. Bd.

GUTHRIE, OKLA.—Bids are asked until 4 p. m., July 14, by E. W. Kinnan, City Clk., for the construction of district sewer No. 38.

DENVER, COLO.—Bids were opened on June 24 by the city for constructing a sanitary sewer in district No. 11 as follows: Gaffy & Keith, $69,866; Gibbons & Hughes, $77,659; National Construction Co., $71,791; Denver-Pueblo Construction Co., $83,084.

SEATTLE, WASH.—The City Council has passed ordinances providing for the following street improvements: 17th Ave. South and other streets, sewers, $18,000; Beacon Ave. and other streets, sewers, $10,500; 24th Ave., N. W., and other streets, sewers, $10,200; First Ave., N. E., and other streets, sewers, $5,695; West 61st St. and other streets, sewers, $20,673. R. H. Thomson is City Engr.

SEATTLE, WASH.—Bids will be asked in about two months for the construction of the Lake Union section of the North Trunk sewer. Estimated cost, about $500,000. List of approximate quantities is on file at the office of Engineering News, New York.

BELLINGHAM, WASH.—Bids are asked by the city until July 13 for the construction of trunk sewer for the north side of the city.

SALT LAKE CITY, UTAH.—A. J. Davis, Acting Mayor, on June 27 signed the contract awarded to DAVIS & HEUSER by the City Council on June 22, for the construction of sewer extension No. 186, at $54,506. This is the contract which has been vigorously fought by several members of the Council since the contract was first awarded by Board of Public Works several weeks ago.

GARBAGE DISPOSAL.

NEW YORK, N. Y.—Bids are asked by Foster Crowell, Comr. St. Cleaning, until noon, July 28, for the final disposition of all ashes, street sweepings and rubbish collected in the Borough of Brooklyn, City of New York. The period of the above contract will be five years beginning December 29, 1908.

BUFFALO, N. Y.—Bids were opened on June 29 by F. G. Ward, Comr. Pub. Wks., for the collection and disposal of ashes, garbage, and refuse. The lowest bid submitted was that of the Buffalo Fertilizer Co., at $7,000 per month.

COLUMBUS, OHIO.—All bids submitted on June 25 for the construction of a garbage reduction plant may be rejected by the Board of Public Service as excessive. New bids may be asked. John H. Gregory is Engr.

STREETS AND ROADS.

(denotes that this work is advertised in Engineering News.)*

ADAMS, MASS.—The following bids have been received by the Board of Selectmen for paving Park St.: Ley Construction Co., Springfield, Mass., Mack block, $2.85; Johnsonburg, $2.82; Shawmut, $2.77. J. McCourt & Co., Boston, Mack, $2.79; Johnsonburg, $2.84; Shawmut, $2.79; Metropolitan, $2.90. Hoflick & Co., North Adams, Mass. (two bids), with grand concrete, Johnsonburg, $2.47; Shawmut, $2.61; Park, $2.60; (with crushed stone concrete) $2.58, $2.72 and $2.71, respectively. Sylvester Connolly & Diamond, Boston, Mass., Mack, $2.87. FIELD, BARBER & UNDERWOOD, Philadelphia, Pa., Mack., $2.42; Patten Pavers, $2.41; Clearfield, $2.49; Pennsylvania Clay, $2.51 (awarded contract on Mack block). R. W. Sherman, of Utica, N. Y., Mack, $2.75, wood block with creosote and oil treatment, 3½-in. blocks, $3.37; with 3-in. blocks, $3.25. Dollar & Holler, Albany, N. Y., Mack, $2.47; Pennsylvania Clay, $2.47; Clearfield, $2.47. H. C. Wood & Co., North Adams, Mack, $2.72; Shawmut, $2.65; Pennsylvania Clay, $2.65; Clearfield, $2.65. U. S. Wood Preserving Co., 71 Broadway, New York, 3½-in. blocks, $3.35; 3-in. blocks, $3.15.

HARTFORD, CONN.—The following contracts for road construction, bids for which were opened at the office of the State Highway Commissioner, Capitol, on June 27, have been awarded as follows Town of East Haddam, 1,900 lin. ft. of macadam road, to the LANE CONSTRUCTION CO., Meriden, Conn., at $2.44 per lin. ft. for macadam and 60 cts. per sq. yd. for cobble gutters. Other bidders were: A. Brazos & Sons, Middletown, Conn., $2.85 and $1.40; Amos Bridges' Sons, Hazardville, Conn., $2.63 and 75 cts.; B. D. Pierce, Jr., Co., Bridgeport, Conn., $2.51 and 65 cts.; town of Putnam, 3,265 lin. ft. of gravel telford, including one 12-in. tile culvert, to AHERN BROS., North Stonington, Conn., at 88 cts. per lin. ft. for straight gravel and $1.35 for gravel-telford. Other bidders were: A. Brazos & Sons, Middletown, $1.30 and $1.70; F. H. Wood, Putnam, Conn., $1.34 and $1.65; B. D. Pierce, Jr., Co., Bridgeport, 99 cts. and $1.75; town of Old Lyme, two sections, 7,400 lin. ft. of gravel and 3,800 lin. ft. of macadam, including one 12-in. and two 15-in. tile culvert, to the LANE CONSTRUCTION CO., Meriden, Conn., at 60 cts. for gravel and $1.57 for macadam. Other bidders were: Pierson Engineering & Construction Co., Bristol, Conn., 70 cts. and $1.75; A. Brazos & Sons, Middletown, 98 cts. and $1.98; Amos Bridges' Sons, Hazardville, 86¼ cts. and $1.98; F. Arrigoni & Bro., Durham, Conn., $1.08 and $1.98; B. D. Pierce, Jr., Co., Bridgeport, 78 cts. and $1.73. Bids were also submitted for a macadam-telford road, as follows: Pierson Engineering & Construction Co., $2; A. Brazos, $2.24; Amos Bridges' Sons, $2.48; Lane Construction Co., $1.97; F. Arrigoni, $2.52; B. D. Pierce, Jr., Co., $2.43.

HARTFORD, CONN.—Bids for furnishing and laying 1,850 sq. yds. of sheet asphalt on Ford St., from Asylum to Pearl St., are asked by the Board of Contract and Supply until 11 a. m., July 13. In this connection the street railway company will lay 1,380 sq. yds. James B. Perry is Secy. Bd.

HARTFORD, CONN.—The following contracts, bids for which were opened on July 6, have been awarded by the State Highway Commissioner: Town of Berlin, 1,525 lin. ft. of macadam and 4,000 lin. ft. of telford, to the LANE CONSTRUCTION CO., Meriden, Conn., $1.20 per lin. ft. for macadam and $1.54 per lin. ft. for telford. Other bidders were: Pierson Engineering & Construction Co., Bristol, Conn., $1.40 and $2.20; A. Brazos & Sons, Middletown, Conn., $1.68 and $2.15; O. T. Benedict, Pittsfield, Mass., $1.69 and $2.19; Connecticut Contracting Co., P. Suzio, Mgr., Meriden, $1.49 and $2.40; Amos Bridges' Sons, Hazardville, Conn., $1.69 and $2.18; C. W. Tryon, Meriden, $1.54 and $2.54; Joseph Mascetti, Torrington, Conn., $1.75 and $2.65; Thomas Kearney, Meriden, $1.45 and $2.20; the B. D. Pierce, Jr., Co., Bridgeport, Conn., 72 cts. and $1.37 per sq yd. The contract calls for two 24-in. and one 20-in. tile pipe culvert. Town of North Haven, 12,760 lin. ft. of macadam-telford road, to LAWRENCE BRUCE, North Haven, Conn., at $16,439, including three 12-in. and one 15-in. culverts. Other bidders were: F. Arrigoni & Bro., Durham, Conn., $19,576; O. T. Benedict, Pittsfield, Mass., $20,239; Amos Bridges' Sons, Hazardville, $19,971; Thomas Kearney, Meriden, $19,182.

BROOKLYN, N. Y.—The following bids were received on July 1 by Bird S. Coler, Boro. Pres., for regulating and repaving with asphalt on a concrete foundation Smith St., from Fulton St. to Atlantic Ave.: Barber Asphalt Paving Co., 30 Church St., New York, $7,621; Cranford Co., 52 Ninth St., Brooklyn, $7,841; Brooklyn Alcatraz Asphalt Paving Co., 407 Hamilton Ave., Brooklyn, $7,054; Uvalde Asphalt Paving Co., 1 Broadway, New York, $7,018.

NEW YORK, N. Y.—The following bids were opened by the Park Board on July 2 for furnishing all the labor and materials for reconstructing the roadway of the Eastern Boulevard, in Pelham Bay Park, including surfacing with asphaltic mixture, from the split rock road to the northern boundary of Pelham Bay Park, in the Borough of the Bronx, City of New York: Sicilian Asphalt Paving Co., 41 Park Row, New York, $1.70 per sq. yd.; Gore-Duggan Eng. Co., 206 Broadway, New York, $1.99 per sq. yd.; Uvalde Asphalt Paving Co., 1 Broadway, New York, $2.10 per sq. yd. Henry Smith is Pres. Bd.

*SILVER CREEK, N. Y.—All bids for paving Main St. were rejected on June 29 by the village. New bids are asked until July 13. C. B. Livermore is Village Clk.

NIAGARA FALLS, N. Y.—All bids for improving Cleveland Ave. were rejected on June 29 by the Board of Public Works. The bidders were Frank E. V. Bardol, 401 Morgan Block, Buffalo, N. Y., for brick, $53,221; H. P. Buryard, 275 Lathrop St., Buffalo, Asphalt, $55,271.

BUFFALO, N. Y.—The following bids were opened on June 29 by F. G. Ward, Comr. Pub. Wks., for asphalt repair work: German Rock Asphalt & Cement Co., Ltd., Morgan Bldg., Buffalo, $1.15 per sq. yd.; Barber Asphalt Co., 822 Ellicott Square, Buffalo, $1.17; Warner-Quinlan Co., $1.21; Henry P. Burgard, Buffalo, $1.21.

KINGSTON, N. Y.—The City Engineer has estimated the cost of paving Broadway with shale brick at $157,675.

UTICA, N. Y.—FRANK M. JOHNSON was awarded the contract on June 30 by the Board of Contract and Supply for paving Burnet St. with vitrified brick at $3,149.

TROY, N. Y.—The Board of Contract and Supply on June 16 awarded to the NORTH HUDSON CONTRACTING CO. the contract for repairing asphalt pavements on Sixth Ave., Rensselaer St., Fifth Ave., Eighth St., Seventh St., State St., Union St. and Maple Ave. The price is regulated by the size of the patch to be made. The following are the prices per sq. yd.: Piece of pavement more than 100 sq. yds. in size, $2.30; between 50 and 100 sq. yds., $2.35; between 20 and 50 sq. yds., $2.40; between ten and 20 sq. yds., $2.50; between five and ten sq. yds., $2.55; under five sq. yds., $2.60.

ALBANY, N. Y.—M. F. DOLLARD, Albany, was awarded the contract on June 22 by the Board of Contract and Supply for paving Plum St., from Dallius to Franklin Sts., at $6,995. Walter Melius is City Engr. List of bidders noted last week.

ROCHESTER, N. Y.—The Board of Contract and Supply on July 1 opened bids for resurfacing with trap rock Meigs St., from East to Monroe Aves. The lowest bid was submitted by H. B. Hooker & Sons at $6,750. Other bidders were: Rauber & Vicinus, $7,100; F. C. Lauer & Sons, $7,270; Brayer & Albaugh, $7,472; H. N. Cowles, $7,680; Thomas Holahan, $8,120.

WEST HOBOKEN, N. J.—The Town Council on June 24 approved the specifications for repaving Clinton Ave. with bitulithic.

WEEHAWKEN, N. J.—Bids are asked until 8 p. m., July 13, by the Township Committee for regulating and paving with bitulithic pavement a portion of Hamilton Ave. George W. Bond, Jr., 146 Bullsferry Road, is Township Engr.

*HACKENSACK, N. J.—Bids are asked until 3 p. m., July 24, by the Board of Chosen Freeholders, Hackensack, for improving the Paterson plank road in Bergen County.

*RIVER VALE (Hillsdale post-office), N. J.—Bids are asked by the River Vale Township Committee, until 7 p. m., Aug. 1, for macadamizing Leslie and Westwood Aves. H. G. Hering, Jr., Hillsdale, is Engr.

*WOODBURY, N. J.—Bids are asked by R. G. Sparks, City Clk., until 8 p. m., July 14, for paving about 5,800 sq. yds. on South Broad St. with Warren's bitulithic pavement. William M. Carter, 127 South Broad St., Woodbury, is Engr.

READING PA.—Bids were opened at the State Highway Department on June 25 for three sections of road in North Lebanon Township. On two sections McCormick & Co. were low bidders at $13,200 and $16,500; R. A. Malone & Co., Lancaster, were low bidders on another section at $16,991.

WILKES-BARRE, PA.—Bids are asked by James M. Norris, County Controller, until 2 p. m., July 20, for constructing a macadam road in two sections between Wilkes-Barre and Pittston.

PITTSBURG, PA.—The Grand Jury on June 22 approved the plans of the County Commissioners for the repair of 56.16 miles of county roads at a cost of $974,089.

BALTIMORE, MD.—All bids for paving 24th St., from Charles to St. Paul Sts., were rejected by the Board of Awards on July 1, and the contract will be readvertised. J. Barry Mahool is Pres. Bd.

POTOMAC, MD.—The Potomac District has voted $20,000 bonds to construct a road from Potomac to the Conduit road, about five miles.

*WASHINGTON, D. C.—Bids are asked by the Commissioners of the District of Columbia until noon, July 18, for grading and regulating suburban streets and avenues.

EMPORIA, VA.—Bids are asked until noon, July 20, by W. R. Cato, Chn. State Highway Comn., for the construction of six miles of gravel roads.

RICHMOND, VA.—The city will repave Main St., from Seventh to Twelfth Sts., with granite blocks, crevices between the blocks to be filled with tar and asphalt. Bids will soon be asked. Charles E. Bolling is City Engr.

CHARLESTON, S. C.—Bids are asked by the city until July 21 for the construction of 30,000 sq. yds. of vitrified brick roadway. J. H. Dingle is City Engr.

*ROME, GA.—Bids are asked until 4 p. m., Aug. 4, by C. E. McLin, Chn. Bd. Pub. Wks., for grading, curbing and the paving certain streets with either wooden block, vitrified brick, granite or bitulithic material. The work will embrace approximately the excavation of 12,000 cu. yds. of earth; furnishing and setting 12,000 lin. ft. of granite curb and concrete foundations; and surfacing 41,000 sq. yds. of pavement. Specifications may be procured and plans and profiles seen at the office of the Resident Engineer, Rome. Hazelhurst & Anderson, Candler Bldg., Atlanta, Ga., are Engrs.

JACKSONVILLE, FLA.—Bids are asked until 2.30 p. m., Aug. 3, by the Board of Public Works for grading an area of approximately 5,200 sq. yds., and for furnishing and placing in position approximately 2,736 lin. ft. of stone curbing and 12 circular corner stones of a radius of 6 ft., and for furnishing on the street and laying about 5,200 sq. yds. of vitrified paving blocks of some standard brand with which to pave Fourth St., from Main to Pearl Sts. Philip Prioleau is City Engr.

FORT DADE, FLA.—Bids for constructing brick roads at Fort Dade, were received by the Constructing Quartermaster, on June 22, as follows: Davis & Cassidy, Egmont, Fla., $2.53 per sq. yd.; Henry Monk, Kimball Park, Atlanta, Ga., $3.40 sq. yd.

NATCHEZ, MISS.—The Adams County Commissioners have awarded the contract to GIBSON & HALE of Natchez, at $26,236 for repairing public roads for a period of two years.

MERIDIAN, MISS.—The city has awarded the contract to the SOUTHERN PAVING & CONSTRUCTION CO., of Chattanooga, Tenn., for paving residence streets with vitrified brick and wood block at about $200,000. J. H. Rivers, Mayor; W. G. Witmore is City Engr.

*JOHNSON CITY, TENN.—KELLY BROS., Portsmouth, Ohio, have contract at $44,000 for paving the business section of Johnson City. L. N. Wilson is City Engr.

BLOUNTVILLE, TENN.—Sullivan County has voted $100,000 of bonds for road improvements.

LEXINGTON, KY.—F. T. Justice & Co., Lexington, are the lowest bidders at 14 cts. per sq. ft. for constructing concrete sidewalks on Woodland Ave., and at 45 cts. per lin. ft. for guttering and curbing.

No bids have been received for paving Woodland and Columbia Aves. with macadam. John Skain is Mayor.

WOODSFIELD, OHIO.—See under Sewerage.

CINCINNATI, OHIO.—The County Commissioners on June 30 awarded the contract for the improvement of the Blue Rock pike from Colerain pike to the Big Miami River road in Green and Colerain Townships, to JOSEPH GRADISON at $60,945.

DUNKIRK, IND.—Bids are asked until 8 p. m., July 20, by the Common Council for the construction of cement sidewalks 4 ft. wide and the construction of the necessary cement street and alley crossings on both sides of a portion of Pleasant St.

GREEN CASTLE, IND.—The Commissioners of Putnam County have awarded a contract to construct the Stanley gravel road in Mill Creek Township and the Craver road in Floyd Township to F. M. GILDWELL at $5,299, and the Stewart road in Jackson Township to JOHN F. CURREN at $5,300.

FORT BENJAMIN HARRISON (Lawrence post-office), IND.—DANIELS & LIST, of Anderson, Ind., have been awarded the contract for the construction of macadamized roads here at $14,000.

ESCANABA, MICH.—Bids are asked until noon, July 15, by the Board of County Road Commissioners for macadamizing a portion of the county road. A. P. Smith is County Clk. and Clk. Bd.

*OWOSSO, MICH.—Bids are asked by the Board of Public Works until 2 p. m., July 15, for paving Michigan Ave. from Main St. to the Grand Trunk R. R.

TAYLORVILLE, ILL.—The Board of Local Improvements has awarded the contract for paving Franklin and South Cherokee Sts., eleven blocks, with brick, to the MERCANTILE BRIDGE & CONCRETE TILE CO., of Paris, Ill., at $27,201. The other bidders were: Hamm & Barbré, $31,313; Samuel Anderson, $32,714.23. The estimated cost of the improvement, according to the figures of the City Engineer, was over $4,000 higher than the bid of the successful firm.

DUBUQUE, IOWA.—Bids are asked until 8 p. m., July 9, by the Council for paving a portion of Sixth St. with brick. Edmund A. Linehan is City Recdr.

LINCOLN, NEB.—On June 15 the Paving Committee recommended to the Council that the Metropolitan Engineering & Construction Co. be awarded the contract for four asphalt paving districts at $1.90 per yd. and 53 cts. per ft. for curbing.

ANACONDA, MONT.—The contract for paving North Main St. has been awarded to JAMES WELCH at $3.98 a sq. yd. for stone paving, 75 cts. a lin. ft. for curbing and $630 for storm sewers and catch basins. The successful contractor was the lowest bidder, the other figures on the paving running from $5.60 to $6.28 a sq. yd.

KANSAS CITY, MO.—The city on June 25 awarded the contract to the PARKER-WASHINGTON CO., 2300 Penn St., Kansas City, at from $1.75 to $1.79 per sq. yd. for paving various streets with Utah asphalt.

The CLEVELAND-TRINIDAD PAVING CO., 1923 Forrest Ave., Kansas City, secured the contract at $1.94 per sq. yd. for paving 24th St.

HOT SPRINGS, ARK.—We are officially advised that the city has formed four improvement districts for street paving aggregating 42,000 sq. yds. of street paving and 17,000 sq. yds. of street railway paving. Plans and specifications are being prepared by F. V. P. Ellsworth, City Engr.

PASADENA, TEX.—Bids are asked until noon, July 14, by John B. Ashe, County Audr., Houston, Tex., for grading the Allen and Genoa road to Pasadena.

BRADY, TEX.—The city has voted $20,000 of bonds for street improvements.

HOUSTON, TEX.—The Harris County Commissioners have awarded contracts as follows: To HADEN & SMITH, of Houston, at $6,163, for paving one mile on the Crosby and Liberty County road; to W. S. HIPP, of Houston, at $17,486, for paving 2¼ miles on Main St. with crushed rock, and at $5,633 for paving one mile on Leeland Ave. road with crushed rock.

The contract recently awarded to W. S. Hipp for constructing five miles on the West Montgomery road has been cancelled, and new bids are asked until July 14.

AFTON, OKLA.—The city will have several miles of concrete sidewalks constructed.

SPOKANE, WASH.—A resolution to pave all streets and avenues between Howard St. and Hangman Creek, and Fourth Ave. and the river, embracing 19 streets and six avenues, was adopted by the City Council on June 23. J. C. Ralston is City Engr.

SEATTLE, WASH.—The City Council has passed ordinances providing for the improvement of the following streets and avenues: Grading—22d Ave., S. W., and other streets, $5,400; Pinedlas Pl. and other streets, $25,400; West Hinds St., $6,575; 18th Ave., N. W., and other streets, $18,915; Washington Boulevard and other streets, $50,500; West 60th St., $2,800; 21st Ave., N. W., and other streets, $12,800; 9th Ave., N. W., and other streets, $20,000; Keystone Pl., et al., and other streets, $29,200; Jones Ave., N. W., and other streets, $17,750. Concrete walks—Aurora Ave., $31,300; 24th Ave., N., and other streets, $6,000; First Ave. and other streets, $4,700; 25th Ave. North and other streets, $26,100; 11th Ave. North and other streets, $16,940; 14th Ave. South, $1,700; First Ave. West and other streets, $6,400; Broad St. and other streets, $4,390; Lake View Ave., $4,300; 15th Ave., N. E., and other streets, $3,650; 20th Ave., N. W., and other streets, $3,290; 19th Ave., N. W., and other streets, $4,320; Fourth Ave., N. E., and other streets, $21,200; Holgate St., planking, $6,000; Dearborn St. and other streets, planking, $5,700; Washington St. and other streets, asphalt paving, $106,000; Terry Ave. North and other streets, planking, $13,400; Queen Anne Ave. and other streets, asphalt paving, $17,700; East Aloha St. and other streets, asphalt paving, $39,405.

ELLENSBURG, WASH.—The Chicago, Milwaukee & St. Paul Ry. Co. will soon commence operations on a boulevard that is to be constructed on and around Craig's hill. Estimated cost, $25,000.

SEATTLE, WASH.—We are officially advised that the contract for improving Olive St. and other streets was awarded on June 30 by the city to HAWLEY & LANE, Fourth Ave. and Olive St., Seattle, at $56,015. Other bidders were: C. J. Erickson, 1512 Fifth Ave., Seattle, $85,982; John Kalberg & Co., Seattle, $61,089; Holt & Jeffery, 310 Hinckley Block, Seattle, $62,993. R. H. Thomson is City Engr.

OLYMPIA, WASH.—Bids are asked until 2 p. m., July 17, by the State Highway Board for clearing and grubbing, grading, bridging, draining and surfacing sections of state roads Nos. 1 and 7. Joseph M. Snow is State Highway Comr.

LETHBRIDGE, ALTA.—The Council has awarded the contract for street grading to JANZ BROS. & MACDONELL, and for cement sidewalk to MARSHALL, BATCHELLER & SKAIRIN, of Calgary, Alta. The contracts aggregate $75,000.

MANUFACTURING PLANTS.

(denotes that this work is advertised in Engineering News.)*

WINTHROP, ME.—Wadsworth & Woodman will begin at once rebuilding their oilcloth factory which was destroyed by fire recently. The factory employed 60 hands. The heating and power plant and the storehouse were not burned.

LE ROY, N. Y.—The management of the Le Roy Cotton Mills, of Le Roy, will build an addition. The new building will be 48 × 150 ft. and will be equipped with combers to spin yarns used in the manufacture of mercerized goods. The output will be from 4,200 to 6,000 lbs. weekly. The capacity may be doubled soon.

WATERVLIET, N. Y.—Announcement is made by the Delaware & Hudson Co. that all the lands needed for the erection of the company's shops in the town of Watervliet had been purchased. The proposed shops are to be located south of the boundary line of Watervliet in the towns of Watervliet and Colonie and are to cost about $2,000,000. The shops, when completed, will be used by the company for repairing its engines and cars at the shops and for building passenger and freight cars. In connection with the shops, and before the work is begun, a spur will be constructed from the present tracks of the company north of the Spring St. road in Colonie to the site of the buildings in order to afford better transportation facilities for the building materials. Before the work of building is commenced, excavation will need to be done to place the ground in condition, and at certain points filling will have to be done. The proposed buildings are to be placed on concrete foundations, and it is stated the superstructure will be fireproof. It is estimated that the shops will give employment to 2,000 men, and the company contemplates the erection of about 150 dwelling houses for their use. James MacMartin, Albany, N. Y., is Ch. Engr.

SCRANTON, PA.—William A. Lush will erect a silk mill at North Scranton. Construction will be started at once on a 1-story brick building, 125 × 45 ft. The mill will employ 75 hands. Cost, about $30,000.

PHILADELPHIA, PA.—Plans have been prepared by C. E. Rahn, Arch., 410 Walnut St., Philadelphia, for a 3-story factory building for William Frisien.

ROOK (Crafton post-office), PA.—The Wabash-Pittsburg Terminal Ry. Co. and the West Side Belt R. R. Co. will construct shops at Rook, where about 700 men will be employed. The companies will withdraw from Norwalk, Ohio, where their repair work has been done at the shops of the Wheeling & Lake Erie R. R. Co. J. E. O'Hearne, Norwalk, Ohio, is Master Mechanic and H. T. Douglas, Jr., Pittsburg, Pa., is Ch. Engr.

NORFOLK, VA.—The Farmers' Mfg. Co., Calvert St., Norfolk, will erect a crate and barrel plant, 100 × 100 ft. The building will cost $25,000 and the machinery $50,000. L. B. East is Mgr.

MAYODAN, N. C.—The Mayodan Mills, of Mayodan, N. C., were damaged about $40,000 by fire recently. The management will arrange at once to repair the buildings and replace the machinery that is not fit for further use. This company has an equipment of about 32,000 spindles, manufacturing cotton yarns.

CHARLOTTE, N. C.—The Jewell Cotton Mills, Charlotte, N. C., recently organized with a capital stock of $250,000, is planning to build its proposed plant. It is stated that the management intends to build a structure with a capacity of 12,000 spindles, but will install only half that number to begin with. The equipment will be arranged for the production of 60s to 100s 2-ply combed yarns for mercerizing. The company is composed of experienced cotton manufacturers. Its officers are: W. W. Hagood, Pres.; W. A. Watson, Vice-Pres.; T. J. Lillard, Secy.-Treas.; Paul Chatham and H. C. Henderson, Dirs.

ATLANTA, GA.—A 3-story factory, 170 × 200 ft., to cost $100,000 will be built jointly by the Binder's Frame Mfg. Co., 85 South Forsyth St., and the Empire Printing & Box Co., 155 Madison St.

The Southern Wood Preserving Co., Peters Bldg., Atlanta, recently incorporated, will establish a plant to manufacture creosoted wooden paving blocks. The equipment to include one 50-ft. 6½-in. creosoting cylinder, working pressure capacity 175 lbs.; two storage creosote tanks, 12,000 gallons each; a 125-HP. engine and two pumps. R. H. White is Pres.; S. E. Finley is Vice-Pres. and Treas.

FORT ST. PHILIP, LA.—Bids are asked until July 20 by Capt. Arthur Cranston, Q. M., New Orleans, La., for constructing an addition to the ordnance machine shop at this post.

CLEVELAND, OHIO.—The McGeorge Engineering Co., Century Bldg., Cleveland, advise us that the building for the Peerless Motor Car Co. will be approximately 106 ft. wide and 144 ft. long, and is to be of brick, steel and reinforced-concrete construction. The second floor will consist of a gallery 30 ft. wide, running around the four sides of the building, the center portion being open up to the roof. This center portion will be covered with a skylight about 35 ft. wide. Contracts have been awarded at the following approximate figures: GRIESE & WALKER, Cleveland, Ohio, general contract, $19,000; MASTERS & MULLEN CONSTRUCTION CO., Rose Bldg., Cleveland, reinforced-concrete floor, $4,000; THE INTERSTATE ENGINEERING CO., Bedford, Ohio, structural steel, $5,000; DEWSTONE & BRAINARD, 2076 East 22d St., Cleveland, plumbing and sewering, $2,000. Total, about $30,000.

BYESVILLE, OHIO.—DICKISON & FOREMAN, of Marietta, Ohio, have secured contract to build an addition to the plant of the Byesville Foundry & Machine Co.

MONON, IND.—The Monon Cement Tile Co. has been incorporated and capitalized at $15,000. The company will erect and equip a plant to manufacture drain tile, sewer tile, fence posts and other cement products. John S. Sandy, Harry A. Bond and Edward E. Sluss are Dirs.

EVANSVILLE, IND.—The W. A. Browning Co. will ask for bids for constructing and equipping a mill on Kentucky Ave. and Canal St. Estimated cost, $25,000.

WINDFALL, IND.—The Windfall Grain Co., recently incorporated, will ask for bids soon for erection of a mill and a grain elevator. George C. Woods and J. C. Hadley are Dirs.

INDIANAPOLIS, IND.—McMeans & Tripp, Engrs., State Life Bldg., Indianapolis, advise us that contract for erecting two 2-story canning factories has been awarded to ALBERT VON SPRECKELSEN, North St. and Highland Ave. The plumbing contract has been let to HAYES BROS., 437 Indiana Ave.

CADILLAC, MICH.—The Cadillac Turpentine Co. has had plans prepared for a plant. The buildings will include a boiler-house, 40 × 56 ft.; engine-room, 45 × 50 ft.; retort house and refinery, 50 × 90 ft., three stories; two warehouses, and an office building and laboratory. W. L. Saunders, of Cummer-Diggins & Co., is Pres. of the company.

MANISTEE, MICH.—The following contracts have been let for the erection of a watch factory: Carpenter work, GUST PETERSON; masonry, NELSON & HANSON, and heating, lighting and plumbing, LLOYD & SMITH, all of this city. The TRUSSED CONCRETE STEEL CO., of Detroit, will construct the reinforced-concrete piers, floors and roof. The building will be 70 × 150 ft., with two wings, 30 ft. wide.

DETROIT, MICH.—The Ford Motor Co. will erect a plant in Highland Park. The main building will be 865 ft. long, 75 ft. wide and four stories high. It will be built of reinforced concrete and steel. There will be also a separate office building, a power-house and several buildings with saw-tooth roofs. Albert Kahn, Union Trust Bldg., Detroit, is Arch.

CHICAGO, ILL.—The Jackson & Corbett Bridge & Steel Co., Rookery Bldg., will build an addition to bridge works on the north branch of the Chicago River south of Webster Ave., covering about 4¾ acres. The land includes 184,000 sq. ft. of land running from Elston Ave. to the north branch of the river south of Webster Ave.

MILWAUKEE, WIS.—H. J. Esser, Arch., 82 Wisconsin St., has completed plans for the 7-story chrome building for the Pfister & Vogel Leather Co. Cost, $50,000.

RACINE, WIS.—The Graham Mfg. Co., 1242 Racine St., has let mason contract to J. ALLEN, and carpentry contract to J. P. HOLM, for a 2-story brick and mill-constructed factory building, 40 × 84 ft. Guilbert & Funston are Archs.

STURGEON BAY, WIS.—The John Hunsader Machine Co., Sturgeon Bay, Wis., has secured a site on the water front affording desirable dock facilities, has commenced the construction of a new plant, 50 × 80 ft., to be built of cement blocks. The plant will be equipped with machinery from the old plant.

GREAT FALLS, MONT.—A creamery is to be built in the Red Butte District, to cost $6,000. J. Mainland, Great Falls, is Mgr.

The Rocky Mountain Elevator Co., of this city, has awarded to the L. O. HICKOK & SON, Flour Exchange, Minneapolis, contract for three $30,000 grain elevators, to be built at Cascade, Belt and Mendon, Mont.

RICH HILL, MO.—The Rich Hill Sewer Pipe Co., recently incorporated, will establish a plant to manufacture sewer pipe, flue lining, fireproofing and other clay products; capacity 1,400 cars finished goods per year. The company will erect 3-story brick buildings, 96 × 192 ft. and 80 × 80 ft., and a brick boiler and engine room, 48 × 48 ft., 16 kilns. Cost of buildings, $30,000; cost of machinery, $22,000; cost of kilns, $30,000. G. G. Milgate and J. D. Fowler are interested.

OKLAHOMA CITY, OKLA.—Detter Canning & Packing Co., recently incorporated with $10,000 stock, will establish a temporary plant for canning summer fruits and vegetables, it is stated. The company contemplates increasing capital stock to $50,000 next winter, when work will be commenced on permanent plant. The plans of the company call for a $10,000 brick building, 50 × 145 ft., two or three stories high; general packing machinery with a daily capacity of 25,000 cans. James Reed is Pres.; W. F. Bush, Vice-Pres.; C. E. Detter, Secy.-Treas.

LACHINE, QUE.—We are officially advised that H. C. Stone, 48 St. Francois Xavier St., Montreal, Que., has been selected to prepare plans for the locomotive plant to be built here by the Imperial Locomotive & Machine Works. L. Edye, Montreal, Que., is Comr.

VANCOUVER, B. C.—E. J. Skeans, of this city, has completed arrangements for the erection of a saw mill on the Alberni Canal. The mill will have an initial capacity of 75,000 ft. per day. Estimated cost, $75,000.

MISCELLANEOUS CONTRACTS.

(denotes that this work is advertised in Engineering News.)*

U. S. RECLAMATION SERVICE.—All news relative to canal projects, etc., will be found under Water Supply—Irrigation.

SCOWS.—New York, N. Y.—Bids are asked until noon, July 21, by Foster Crowell, Comr. of St. Cleaning, for the construction of 15 scows.

WELL.—Medicine Hat, Alta.—Bids are asked until July 18 by the city for drilling a 6-in. and an 8-in. gas well. W. B. Morrison is City Engr.

DRAINAGE.—Forest City, Iowa.—Bids are asked by the County Board of Supervisors until 9 a. m., July 14, for construction of drainage improvement known in Winnebago County as Drainage District No. 2, and in Worth County, Iowa, as Drainage District No. 3.

ENGINES.—Prince Albert, Sas... asked by C. O. Davidson, ... until July 31 for a 4-wheeled ... inder chemical engine, and also ... haul chemical engine.

*WHARF.—Fort Mott, N. J. ... asked until 11 a. m., July 31, by ... Knowlton, Constructing Q. M., U. ... Dupont, Delaware City, Del., for ... the wharf at this post.

LUMBER.—New York, N. Y. ... asked by Allen N. Spooner, Comr. ... until noon, July 20, for furnishing ... labor and materials required in ... ing and delivering lumber.

CHANNEL.—Port Colborne, ... are asked by L. K. Jones, Secy. ... ways and Canals, Ottawa, Ont., ... 13 for widening deep water cha... the west pier, Welland Canal.

PAINTING RAILING.—New Yo... Bids are asked by the Departmen... until 3 p. m., July 16, for painting ... iron railing along Harlem River ... from 155th St. to Dyckman St.

DREDGING.—Osterville, Mass., ... asked by the Harbor and Land C... ers at Boston until July 17 for ... channel in East Bay at Osterv... town of Barnstable. Frank W. ... Ch. Engr.

DREDGING.—Seattle, Wash.—O... received as follows on June 25 by ... Chittenden, Corps Engrs., U. S. ... dredging Pend Oreille River, Wash., ... cu. yds.: Weens & Adams Co., ... Wash., at 50 cts. per cu. yd.

*STONE, ETC.—New York, N. ... are asked until noon, July 28, by ... Knight, Corps Engrs., U. S. A., ... New York, for furnishing rubble ... quarry spalls and quarry refuse ... constructing and repairing dikes in the Hudson River, N. Y.

LUMBER.—New York, N. Y.—... is are asked until July 16 by James W. ... son, Comr. of Bridges, for furnishing and delivering yellow pine, white pine, oak and spruce lumber, to the Brooklyn bridge; also same date for 400 M. ft. of spruce plank to the Brooklyn bridge.

COAL-HANDLING PLANT.—New York, N. Y.—Bids are asked by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., until 11 a. m., Aug. 1, for a coal-handling plant for the power-house, navy yard, New York. Specifications are on file at office of Engineering News, New York. R. C. Hollyday is Chief of Bureau.

DREDGING, ETC.—Bremerton, Wash.—One bid was received as follows by the Bureau of Yards and Docks, Navy Dept., Washington, on July 3, for dredging material from the water front, navy yard, Bremerton, Wash.: Puget Sound Bridge & Dredging Co., 95 Yesler Way, Seattle, Wash., 60 cts. per cu. yd. R. C. Holliday, Chief of Bureau.

RETAINING WALL, ETC.—Philadelphia, Pa.—Bids are asked until 11 a. m., Aug. 1, by the Bureau of Yards and Docks, Navy Dept., Washington, D. C., for constructing a continuation of the retaining wall and a pier in the reserve basin, navy yard, Philadelphia. R. C. Hollyday is Chief of Bureau. Specifications are on file at the office of Engineering News, New York.

WALLS, ROOF, ETC.—Boston, Mass.—Bids are asked until noon, July 16, by the Boston Transit Commission, B. Leighton Beal, Secy., for building a portion of the walls, roof and invert for the enlargement of the subway under the Boston City Hospital Relief Station, Washington St. tunnel. Specifications and forms of contract can be obtained at 15 Beacon St., Boston, ninth floor.

STRIPPING.—Mulberry, Fla.—The Prairie-Pebble Phosphate Co., of Savannah, Ga., has awarded contract to the FERGUSON CONTRACTING CO., 37 Wall St., New York, N. Y., for stripping about 12,000,000 cu. yds. of earth from its phosphate beds here, a distance of about 40 miles from Tampa. The contract will cover a period of six years. The greater part of the equipment has been purchased. W. C. Merritt is Engr.-in-Charge Joseph Hull, 135 Bay St., Savannah, Ga., is Pres. of the phosphate company.

*CONCRETE WALL.—Riverton, Ala.—Bids were received as follows on June 27 by Major William W. Harts, Corps Engrs., U. S. A., Nashville, Tenn., for constructing concrete river wall at Colbert Shoals Canal, near Riverton: (a) 40 cu. yds. earth excavation; (b) 50 cu. yds. rock excavation; (c) 4,000 cu. yds. concrete; (d) total: Sheridan-Kirk Contract Co., Cincinnati, Ohio, (a) $1 per cu. yd., (b) $4, (c) $10.65, (d) $43,200 (recommended for acceptance); H. S. Bosler and M. P. Flynn, Chattanooga, Tenn., (a) 75 cts., (b) $3.65, (c) $11.34, (d) $45,380.

*DAM, ETC.—Saltpetre, W. Va.—Bids were received as follows on July 2, by Lieut.-Col. J. G. Warren, Corps Engrs., U. S. A., Cincinnati, Ohio, for constructing dam, guide-walls, dwelling, etc., at Lock No. 1, Tug Fork of Big Sandy River, at Saltpetre: The Ohio River Contract Co., Evansville, Ind., $109,220; Mason & Hanger Co., Richmond, Ky., $125,330; Miller Bros., North Vernon, Ind., $113,770; Advance Sand & Construction Co., Crafton, Pa., $128,000; W. W. Lindsay & Co., Harrison Block, Philadelphia, Pa., $123,100; The H. E. Talbot Co., Dayton, Ohio, $142,270.

*RETAINING WALL.—Wilmington, Del.—Bids were received as follows by Edward R. Mack, Park Engr. on July 2, for constructing a reinforced concrete retaining wall, 276 ft. long, along Brandywine Creek at Kirkwood Park, Wilmington: Tateral Brown Co., Wilmington, $7,950; A. B. Griswold, New Britain, Conn., $8,472; A. S. Reed & Bro., Wilmington, $7,300; J. C. Van Trump, Wilmington, $7,820; W. W. Lindsey & Co., Harrison Block, Philadelphia, Pa., $8,490; Concrete Wall Co., Philadelphia, $7,088; Gaud...

Clemons, ... Filbert St., Philadelphia, $7,079; Jas. ... Stetzer, Commonwealth Block, Philadelphia, $8,420.

*BREAKWATER.—Boston, Mass.—Bids were received by the Board of Harbor and Land Commissioners, State House, Boston, on June ... for 7,000 to 8,000 tons of granite quarry ... to build an extension to the breakwater in Vineyard Haven Harbor, Martha's Vineyard. Frank W. Hodgdon, Ch. Eng. ... Contract has been awarded to E. G. ... DEN & SONS, Hartford, Conn., at $1.35 ...

STEEL BARGE.—Newport, R. I.—Bids were received as follows by R. C. Hollyday, Ch. of Bureau of Yards and Docks, Navy Dept., Washington, on June 27, for furnishing two steel floats at the government landing, Newport, R. I.: The Canton Boiler & Engineering Co., Canton, Ohio., $2,986; Bergen Point Iron Works, 149 Broadway, New York, $3,284; Darling & Slade, 56 North Main St., Fall River, Mass., $3,900; American Locomotive Co., 30 Church St., New York, $4,946; Clinton Shipbuilding & Repair Co., Tioga St. and Delaware River, Philadelphia, Pa., $3,261; the Pusey & Jones Co., Wilmington, Del., $5,785; New Jersey Foundry & Machine Co., 90 West St., New York, $6,130 ($5,530 alternate).

*DREDGING, ROCK REMOVAL. — New York, N. Y.—Bids were received on June 30, by Col. John G. D. Knight, Corps Engrs., U. S. A., for dredging and rock removal in Harlem River, N. Y., as follows: Columbia Dredging Co., 64-68 Broad St., New York, 28.85 cts. per cu. yd. scow measurement; R. G. Packard Co., 130 Pearl St., New York, 64 cts.; The W. H. Beard Dredging Co., 21 State St., New York, 29 cts.; P. Sanford Ross, Inc., 277 Washington St., Jersey City, N. J., 42.4 cts.; Maritime Dredging Co., 78 Broad St., New York, 43 cts.; The International Contracting Co., 17 Battery Pl., New York, 48 cts.; The Degnon Contracting Co., 60 Wall St., New York, 48 cts.

PARK IMPROVEMENTS. — Philadelphia, Pa.—Bids were received on June 15 for improving small city parks as follows: The only bidders were A. F. Connell and Daniel S. Bader, the former offering to do all the work for $48,500. The bids for the various improvements were as follows: Clarence H. Clark Park, 43d St. and Woodland Ave.—O'Connell, $4,810; Bader, $5,300. Huntingdon Park, Aramingo St. and Lehigh Ave.—O'Connell, $7,950; Bader, $9,900. Carroll Park, 58th St. and Girard Ave.—O'Connell, $14,390; Bader, $14,500. Plot of ground at 48th St. and Lancaster Ave.—O'Connell, $17,400; Bader, $21,900. Plot of ground bounded by Ann, Mercer, and Almond Sts. and Indiana Ave.—O'Connell, $4,950; Bader, $6,650.

CONTRACT PRICES.

[Where ... precedes items under Contract Prices ... work was advertised in Engineering News.]

*WATER-WORKS SYSTEM.—Mont Alto, Pa.—Bids in detail were received as follows on June 9 by the State Health Department, Harrisburg, for the construction of a waterworks system for the Pennsylvania State South Mountain Sanatorium: (A) W. L. Forney, Chambersburg, Pa.; (B) Charles W. Denny, 1330 Arch St., Philadelphia, Pa.; (C) W. G. FRITZ, York, Pa. (awarded contract); (D) the Ahrens Construction Co., Lewiston, Pa.; (E) Brady & Snaveley, Harrisburg, Pa.; (F) F. A. Havens & Co., Perry Bldg., Philadelphia, Pa.; (G) The Pitt Construction Co., Fulton Bldg., Pittsburg, Pa.; (H) McCay Engineering Co., 9 East Lexington St., Baltimore, Md.; (I) McCormick & Co., 14 South Broad St., Philadelphia; (J) the Engineer's estimate:

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
1 ... reservoir, 60' diam. × 15' deep, incl. all appurt. as specified...	$5,987.00	$13,788.00	$5,752.00	$5,975.00	$5,695.00	$11,263.00	$4,900.00	$6,686.00	$5,072.30	$4,139.90
1 ... reservoir, 27' diam. × 11' deep, incl. all appurt. as specified..	1,068.00	4,790.00	1,650.00	1,950.00	1,580.00	3,551.00	1,850.00	3,852.00	1,923.60	1,098.90
1 ... reservoir, 16' diam. × 6' deep, incl. all appurt. as specified..	388.00	1,780.00	750.00	605.00	608.00	1,340.00	550.00	1,800.00	725.52	374.76
4 ... manholes, 3' diam. × 4' deep, incl. valves, etc., each.....	35.00	290.00	75.00	80.00	71.50	138.00	70.00	80.00	89.20	40.80
3 ... spring covers, 3' × 3' × 4' deep, incl. connections, each....	30.00	290.00	60.00	25.00	50.00	96.00	65.00	90.00	97.20	26.40
2 ... spring covers, 4' × 4' × 4' deep, incl. connections, each....	40.00	385.00	60.00	30.00	60.00	149.00	70.00	95.00	122.10	29.40
1 ... spring cover irregular in plan, 4' deep, incl. connections....	40.00	465.00	70.00	35.00	174.00	233.00	65.00	95.00	156.50	29.40
400 cu. yds. rock excavation.....	1.87	4.25	2.25	2.50	1.50	3.95	6.00	3.00	1.50	2.25
5,100 lin. ft. 6" c.-i. pipe, 4' to 6' deep, including specials.....	1.20	2.20	.75	.81	1.33	1.12	1.10	1.05	1.15	1.20
3,100 lin. ft. 4" c.-i. pipe, 4' to 6' deep, including specials.....	1.05	1.98	.60	.68	1.22	.89	.90	.93	1.15	.95
3,100 lin. ft. 4" w.-i. pipe, 4' to 6' deep, including specials.....	1.13½	1.37	.80	.74	1.22	.89	1.00	.85	1.04	.82
3,100 lin. ft. 4" cement lined pipe, 4' to 6' deep, including specials.....	1.13½	1.54	.75	.85	1.32	.98	1.10	....	1.05	.90
500 lin. ft. 4" c.-i. pipe, 6' to 8' deep, including specials.....	1.20	2.47	.75	.90	1.22	1.04	1.10	1.03	1.17	1.07
500 lin. ft. 4" w.-i. pipe, 6' to 8' deep, including specials.....	1.28½	2.10	.90	.96	1.22	1.04	1.20	.95	1.10	.94
500 lin. ft. 4" cement lined pipe, 6' to 8' deep, including specials.....	1.28½	2.03	.85	1.06	1.32	1.13	1.30	....	1.11	1.02
50 lin. ft. 4" c.-i. pipe, 8' and over deep, including specials.....	1.35	4.56	1.00	1.07	1.22	1.18	1.25	1.15	1.49	1.25
50 lin. ft. 4" w.-i. pipe, 8' and over deep, including specials.....	1.43½	4.18	1.20	1.13	1.22	1.18	1.35	1.05	1.42	1.12
50 lin. ft. 4" cement lined pipe, 8' and over deep, including specials....	1.43½	4.17	1.15	1.14	1.32	1.27	1.45	....	1.43	1.20
4,100 lin. ft. 3" c.-i. pipe, 4' to 6' deep, including specials.....	.92	1.54	.50	.55	1.12	.80	.83	.75	.80	.78
4,100 lin. ft. 3" w.-i. pipe, 4' to 6' deep, including specials.....	.97½	1.37	.50	.61	1.12	.75	.80	.75	.84	.73
950 lin. ft. 3" c.-i. pipe, 6' to 8' deep, including specials.....	1.07	2.03	.90	.78	1.12	.95	1.00	.83	.89	.90
950 lin. ft. 3" w.-i. pipe, 6' to 8' deep, including specials.....	1.12½	1.84	.60	.84	1.12	.90	.95	.83	.95	.85
125 lin. ft. 3" c.-i. pipe, 8' and over deep, incl. specials.....	1.17	4.12	.80	.96	1.12	1.10	1.20	.95	1.46	1.08
125 lin. ft. 3" w.-i. pipe, 8' and over deep, incl. specials.....	1.22½	3.94	.80	1.02	1.12	.98	1.10	.95	1.47	1.02
4,600 lin. ft. 2" w.-i. pipe, 4' to 6' deep, including specials.....	.80	1.24	.40	.44	.96	.56	.65	.60	.57	.44
650 lin. ft. 2" w.-i. pipe, 6' to 8' deep, including specials.....	.95	1.73	.50	.67	.96	.71	.80	.70	.67	.56
3 6" gate valves, including boxes, each.....	20.00	41.37	16.00	21.00	20.00	20.70	20.00	27.00	32.00	20.00
1 4" gate valve, including boxes.....	12.00	28.68	10.00	17.50	16.00	14.95	15.00	22.00	22.00	14.00
7 2" gate valves, in new lines, including boxes, each.....	6.00	19.60	6.00	14.00	12.00	10.35	10.00	16.00	15.00	9.00
5 2" gate valves, in old lines, including boxes, each.....	7.50	30.10	10.00	19.00	16.00	13.80	12.00	16.00	15.00	12.00
5 fire hydrants and 4" gate connections, each.....	35.00	80.98	35.00	42.75	52.00	69.00	45.00	55.00	45.00	45.60
2 5 × 6 single acting triplex pumps, each.....	312.00	592.00	500.00	405.00	479.00	585.00	400.00	725.00	400.00	600.00
2 8-HP. horiz. gasoline engine, each.....	475.00	676.00	637.75	1,825.00	677.00	707.00	650.00	735.00	600.00	690.00
1 3-HP. horiz. gasoline engine.....	350.00	4.56	275.00		594.00	461.00	450.00	410.00	400.00	450.00
1 frame pump house, 20' × 30' × 10'.....	1,100.00	1,050.00	1,000.00	1,275.00	1,248.00	1,049.00	500.00	1,800.00	1,227.00	811.20
Addition to pump house, including appurtenances.....	65.00	125.00	200.00	180.00	195.00	325.00	300.00	300.00	275.00	115.80
20 cu. yds. extra concrete	8.50	8.50	18.00	18.00	15.00	....	15.00	14.00	10.00	8.00
Removing water tank	40.00	165.00	15.00	50.00	52.00	98.00	50.00	200.00	25.00	100.00
Totals	$32,041	$64,534	$25,167	$27,325	$36,486	$40,593	$31,535	$36,901	$31,117	$27,725

SEWER SYSTEM.—Waterloo, N. Y.—Bids were received as follows by John Kropf, Village Pres., on July 1 for furnishing the materials and constructing a system of sewers with sewage disposal plant for the village. Morrison & Farrington, Syracuse, N. Y., are the Engrs. (A) Golden & Lasing, Troy, N. Y.; (B) Swift, Bonn & Co., Syracuse, N. Y.; (C) A. B. GRISWOLD, New Britain, Conn. (awarded contract for disposal plant); (D) Field, Barker & Underwood, Philadelphia, Pa.; (E) A. C. Martin & Co., Seneca Falls, N. Y.; (F) BENNETT & SHEPARD, Niagara Falls, N. Y. (awarded contract for sewers); (G) Honeoye Falls Construction Co., Honeoye Falls, N. Y.; (H) Samuel Beskin, Fishkill, N. Y.; (I) J. B. O'Rourke & Co., South Norwalk, Conn.; (J) Frank S. Tierney & Son, Niagara Falls, N. Y.; (K) A. L. Willey, Binghamton, N. Y.; (L) Lewis & Moynehan, Herkimer, N. Y.; (M) C. T. Hookway, Syracuse, N. Y.; (N) H. M. Sherwood, Baldwinsville, N. Y.:

	(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)	(K)	(L)
8,920 lin. ft. trenching and backfilling under 6'.....	$0.15	$0.40	$0.215	$0.14	$0.17	$0.17	$0.455	$0.23	$0.30	$0.20	$0.35	$0.40
27,900 lin. ft. trenching and backfilling 6 to 8'.....	.23	.50	.38	.25	.22	.27	.725	.40	.39	.36	.43	.55
21,300 lin. ft. trenching and backfilling 8 to 10'.....	.48	.60	.617	.41	.39	.32	1.35	.52	.54	.48	.52	.75
8,100 lin. ft. trenching and backfilling 10 to 12'.....	.79	.90	.81	.85	.85	.42	1.81	.80	.80	.70	.75	1.00
3,400 lin. ft. trenching and backfilling 12 to 14'.....	1.04	1.25	1.405	1.25	1.25	.58	2.45	1.20	1.00	1.00	1.00	1.25
900 lin. ft. trenching and backfilling 14 to 16'.....	1.46	1.50	1.687	2.00	1.75	.70	3.01	1.85	2.00	1.50	2.00	1.50
500 lin. ft. furnishing and laying 5" vit. pipe.....	.07	.15	.00	.11	.20	.15	.17	.12	.17	.10	.08	.10
1,070 lin. ft. furnishing and laying 6" vit. pipe.....	.09	.15	.111	.13	.11	.15	.185	.15	.17	.12	.15	.12
52,940 lin. ft. furnishing and laying 8" vit. pipe.....	.14	.25	.191	.19	.16	.18	.28	.20	.23	.20	.20	.18
4,330 lin. ft. furnishing and laying 10" vit. pipe.....	.21	.35	.315	.28	.23	.22	.37	.31	.30	.23	.25	.25
3,730 lin. ft. furnishing and laying 12" vit. pipe.....	.28	.45	.36	.37	.30	.28	.51	.37	.36	.30	.30	.35
4,150 lin. ft. furnishing and laying 15" vit. pipe.....	.42	.60	.48	.50	.55	.35	.60	.51	.65	.38	.50	.45
2,090 lin. ft. furnishing and laying 18" vit. pipe.....	.54	.75	.648	.70	.65	.49	.71	.70	.85	.55	.60	.58
2,240 lin. ft. furnishing and laying 20" vit. pipe.....	.75	1.00	.82	.88	.80	.69	.87	.95	1.05	.70	.80	.76
40 lin. ft. Y branches in 6" pipe.....	.20	.25	.31	.28	.27	.22	.60	.30	.17	.40	.30	.90
1,900 lin. ft. Y branches in 8" pipe.....	.38	.40	.388	.42	.45	.36	.84	.30	.27	.60	.50	1.05
140 lin. ft. Y branches in 10" pipe.....	.59	.60	.415	.60	.68	.55	1.22	.50	.41	.85	.75	2.40
110 lin. ft. Y branches in 12" pipe.....	.76	.75	.563	.77	.90	.72	1.66	.78	.53	1.10	1.00	3.00
130 lin. ft. Y branches in 15" pipe.....	1.19	1.00	.845	1.00	1.22	1.00	2.86	1.00	.70	1.60	1.55	4.25
90 lin. ft. Y branches in 18" pipe.....	2.12	1.20	1.07	1.40	1.53	2.50	3.50	1.40	.87	2.10	2.00	5.25
70 lin. ft. Y branches in 20" pipe.....	2.29	1.70	1.44	1.75	2.00	4.00	4.40	1.75	1.15	2.75	2.75	7.00
58 manholes under 8'	36.50	40.00	38.00	42.00	33.50	43.00	52.00	50.00	40.00	32.00	40.00	50.00
54 manholes 8' and under 10'.....	43.00	40.00	37.00	50.00	41.00	45.00	60.00	55.00	45.00	35.00	45.00	60.00
17 manholes 10' and under 12'.....	49.75	50.00	42.00	60.00	50.00	50.00	65.00	60.00	47.00	38.00	50.00	75.00
13 manholes 12' and under 14'.....	56.00	60.00	47.00	70.00	60.00	55.00	80.00	65.00	55.00	42.00	55.00	80.00
4 manholes 14' and under 16'.....	62.75	65.00	54.00	90.00	90.00	62.00	90.00	70.00	75.00	50.00	60.00	85.00
5 lampholes	8.00	15.00	9.70	12.00	10.00	15.00	15.00	20.00	20.00	8.00	10.00	17.00
48 flush tanks	57.00	65.00	59.00	62.00	55.00	51.00	60.00	55.00	65.00	48.00	50.00	58.00
15 tons cast-iron pipe	33.00	40.00	39.50	43.00	50.00	27.00	40.00	50.00	45.00	35.00	50.00	45.00
2,650 cu. yds. rock	3.00	2.00	3.00	3.25	3.00	3.00	3.45	2.75	3.00	2.75	3.00	3.50
Totals	$62,147	$82,886	$74,891	$69,301	$63,921	$56,738	$126,621	$65,639	$77,919	$66,911	$75,019	$92,414
Number of days to finish contract.....	200	100	275	300	150	350	250	150	150	150	300	300

Disposal plant:	(A)	(C)	(M)	(E)	(N)	(K)	(L)
310 cu. yds. concrete 1-3-6.....	$8.50	$6.32	$10.00	$8.75	$12.00	$7.00	$10.00
180 cu. yds. concrete 1-2-4.....	10.00	7.36	11.00	10.00	15.00	15.00	12.50
2,000 cu. yds. earth excavation.....	.90	.88	.70	.55	.85	1.00	1.00
9,000 lbs. steel rods.....	.035	.023	.05	.06	.05	.03	.06
2,000 lbs. steel fabric.....	.055	.029	.07	.10	.20	.08	.10
210 lin. ft. vitrified pipe 6 to 15".....	.68	.68	.60	1.60	.75	.50	1.00
50 lin. ft. vitrified pipe 20".....	1.30	1.04	1.40	3.85	1.50	1.00	1.65
170 lin. ft. vitrified pipe 24".....	1.75	1.25	2.00	5.50	2.00	2.00	1.85
1,000 c.-i. force main.....	1.80	1.41	.70	.75	1.50	1.50	1.00
400 double c.-i. siphon.....	11.48	7.01	8.00	8.25	12.00	7.50	14.00
3 wells	175.00	80.25	200.00	300.00	75.00	300.00	225.00
3 manholes	75.00	28.75	70.00	200.00	45.00	100.00	100.00
70 broken stone	2.00	1.95	2.00	2.50	2.50	2.50	2.00
Pump house (lump sum).....	950.00	345.00	400.00	600.00	900.00	3,425.00	1,200.00
Totals	$15,397	$10,717	$12,856	$14,141	$17,277	$17,095	$17,612
Number of days to complete contract.....	200	60	50	150	100	300	150

CIVIL SERVICE EXAMINATIONS.

JUNIOR ARCHITECTURAL DRAFTSMAN.—Washington, D. C.—The U. S. Civil Service Commission announces an examination on July 22-23, to secure eligibles from which to make certification to fill three vacancies in the position of Junior Architectural Draftsman, at $840 to $1,000 a year, in the office of the Supervising Architect, Treasury Dept., and vacancies requiring similar qualifications as they may occur. Age limit, 18 years or over. Application Form 1312.

PHARMACOGNOSIST.—Washington, D. C.—The U. S. Civil Service Commission announces an examination on July 15 to secure eligibles from which to make certification to fill a vacancy in the position of Pharmacognosist in the Bureau of Chemistry, Dept. of Agriculture, at $3,000 a year or such per diem rate as may be agreed upon, not to exceed $3,000 a year, and vacancies requiring similar qualifications as they may occur at the same or lower salary. Competitors will not be assembled for any of the tests. Age limit, 25 to 55 years. Application Form 304 and special form.

AUDITING CLERK (MALE).—Philippines.—The U. S. Civil Service Commission announces an examination on July 22 to secure eligibles from which to make certification to fill vacancies as they may occur in the office of the Chief District Auditor in the Philippnes, at a salary of $1,400 a year. The corps consists of one chief district auditor, at a salary of $3,000 a year; two district auditors at $2,250, and ten each at $2,000 and $1,800 a year; four clerks at $1,600, and two each at $1,400 and $1,200 a year. The entrance salary will be $1,400, and advancement will depend upon the occurrence of vacancies and qualifications and ability shown. Age limit, 18 to 40 years. Application Forms 3 and 375.

ELECTRICAL ENGINEER AND MECHANICAL DRAFTSMAN.—Washington, D. C.—The U. S. Civil Service Commission announces an examination on July 22, 23, 24, to secure eligibles from which to make certification to fill one or more vacancies in the position of Electrical Engineer and Mechanical Draftsman, at an entrance salary of from $100 to $200 a month, and upward, in the Reclamation Service, and vacancies requiring similar qualifications as they may occur. Eligibles from this examination may be appointed as electrical engineers or assistants for the design, installation, or operation of hydro-electric and steam-power plants in the West, or as mechanical draftsmen for office work and drafting in connection with preparation of plans. Age limit, 25 to 45 years. Application Form 1312. Application must be filed prior to closing hour on July 11.

TRADE PUBLICATIONS.

MINE FANS.—The Jeffrey Manufacturing Co., Columbus, O. Catalog No. 26. Paper; 6 × 9½ ins.; pp. 24; illustrated.

A new type of fan has been designed by the Jeffrey Mfg. Co. for high efficiency at slow speeds and against heavy resistance. Single and double inlet fans are shown as well as cases and mountings for them.

DRAWING TABLES AND FILING CASES.—The Economy Drawing Table Co., Toledo, O. Paper; 5½ × 8 ins.; pp. 30; illustrated.

The manufacturers claim that the convenient arrangement of their tables will save a draftsman 15 minutes a day, and that therefore such tables will pay for themselves in six months. The catalog shows a large variety.

MINE AND QUARRY.—Sullivan Mechinery Co., Chicago, Ill. Paper, 6 × 9 ins.; pp. 28; illustrated.

Under the above title a serial pamphlet is issued containing general news of interest to superintendents, engineers and contractors, their attention being drawn to important works using Sullivan machinery. A useful article on "The proper shape for rock-drill bits" is included.

CHIMNEYS.—H. R. Heinicke Co., 147 Fourth Ave. New York City. Paper; 5½ × 8½ ins., pp. 72; illustrated.

This company, which has built a large number of hollow radial brick factory chimneys, has issued a neat booklet, not merely lauding their output, but going fully into the technical details of its production. The subject is treated from the designing engineer's point of view and cannot fail to be of interest to every builder and user.

PRESSURE AND VACUUM GAGES.—Standard Gage Mfg. Co., Hudson Terminal Fulton Bldg., New York City. Bulletin No. 2. Paper; 8 × 11 ins.; pp. 35; illustrated.

The construction, uses and prices of a variety of gages are given in the bulletin. Both high grade and cheaper gages are listed and attention is given to the special requirements in this line of traction engines, of air brake service on locomotives and of automobiles.

For other Proposal Advertisements see pages 43, 44, 45, 47, 51, of Advertisements and Construction News page 18.

NOTICES TO CONTRACTORS.

Sealed proposals, addressed to the Board of Trustees of the Sanitary District of Chicago, and indorsed "Proposals for the Equipment of Ninth Street and Sixteenth Street Swing Bridges," will be received by the Clerk of the said Sanitary District at the offices of the said District on the 15th Floor of the American Trust Building, Chicago, Illinois, until 12 M., Standard Time, on Wednesday, July 29, 1908, and will be publicly opened by the Board of Trustees at a meeting to be held on that day, or the first meeting thereafter.

The work for which said tenders are invited consists of supplying all material, appliances and labor required for the complete equipment, with operating machinery, electric motors, wiring and other necessary parts, of two 2) Highway Swing Bridges crossing the Main Drainage Channel of the Sanitary District of Chicago, so that said bridges may be operated to allow navigation through same in said Main Drainage Channel. Said bridges are counterbalanced, rim bearing swing spans situated in the Township of Lockport, Will County, State of Illinois, and are located as follows:

On the line of Ninth Street (Lockport Road).

At Sixteenth Street (Wire Mills Road).

The equipments of the two bridges are practically alike in character, and both equipments will be awarded under a single contract. The work is to be performed in accordance with plans, specifications and contract form furnished by the Sanitary District of Chicago, which plans, specifications and contract form may be obtained upon application at the said office of the said Sanitary District.

Each bid must be accompanied by a certified check or cash to the amount of Seven Hundred ($700.00) dollars. All certified checks must be drawn on some responsible bank doing business in the City of Chicago, and shall be made payable to the Clerk of the Sanitary District of Chicago. Said amount of Seven Hundred ($700.00) dollars, deposited with bids, shall be held by the Sanitary District until all of the respective bids for said work have been canvassed and the contract awarded and signed. The return of said check or cash to the bidder to whom said work shall have been awarded will be conditioned upon his appearing within ten (10) days after receiving notice of such award, with bondsmen, and executing a contract with the Sanitary District for the work so awarded, and giving a bond, satisfactory to the Board of Trustees, for the fulfillment of said contract for the equipment of said bridges in the amount of Eight Thousand ($8,000.00) dollars.

A deposit of Ten ($10.00) dollars will be required for each set of plans and specifications taken out, said sum of Ten ($10.00) dollars, deposited, to be refunded by said Sanitary District upon the return of said plans and specifications to said District, provided same are returned within twenty (20) days after the date on which said bids are opened.

All bids must be upon blank forms furnished by the Sanitary District.

Bidders are required to state in their bids their individual names and places of residence in full.

The said Board of Trustees reserves the right to reject any and all bids.

THE SANITARY DISTRICT OF CHICAGO,
By ROBERT R. McCORMICK,
President of Its Board of Trustees.
Attest: I. J. BRYAN, Clerk.
Chicago, July 9, 1908.

MACADAM ROAD.

NOTICE TO CONTRACTORS.

Hackensack, N. J.

Sealed proposals for the macadamizing and improving of the Paterson Plank Road in the County of Bergen, State of New Jersey, beginning at the Carlstadt Depot and extending to the Hackensack River, will be received by the Paterson Plank Road Committee at the office of the Clerk of the Board of Chosen Freeholders of Bergen County at the Court House in Hackensack, N. J., and will be there publicly opened at 3 o'clock in the afternoon on Friday, July 24, 1908.

Plans, specifications and cross sections may be examined at the office of the State Commissioner of Public Roads at the State House, Trenton, New Jersey; at the office of the Clerk of the Board of Chosen Freeholders of Bergen County; and at the Court House in Hackensack, New Jersey.

Each bidder must accompany his bid with a certified check drawn to the order of the County Collector of Bergen County in the sum of One Thousand ($1,000) Dollars as a guarantee that if the said work is awarded to him he will enter into a contract with the Board of Chosen Freeholders of the County of Bergen for the due and faithful performance of the work, which contract, together with a bond of the successful bidder must be executed within five days from the time of the formal awarding of the contract by the Board of Chosen Freeholders.

The said bond to be conditioned for the faithful performance of the work in strict conformity with the plans and specifications and in the penal sum of at least the total estimated cost of the work.

Both contract and bond must meet the approval of the State Commissioner of Public Roads.

The Committee reserves the right to reject any or all bids.

MICHAEL HECKER,
A. E. SAGE,
E. T. GALLOWAY,
Committee.

SEWERS.

Milan, Mich.

Sealed proposals for the construction of a Sewer in the Village of Milan, Michigan, will be received at the office of the Village Clerk up to 1 o'clock P. M., Tuesday, July 14, 1908.

Said sewer will be about 3,700 ft. long, 1,900 ft. 24-in., 800 ft. 20-in. and 1,000 ft. 15-in. Average depth about 11 ft.

Bidders are required to furnish a certified check, drawn on a solvent Monroe or Washtenaw Co. bank for $500, made payable to C. W. Pullen, Treas., to insure the successful bidder will enter into his contract.

Specifications and bidding blanks are on file at the Clerk's office, copies of which will be mailed upon request.

The Council reserves the right to reject any or all bids submitted or to waive defects in bids in the interest of the village.

Mail all bids to W. P. GREGORY,
Village Clerk.

U. S. ENGINEER'S OFFICE, 57 Park St., Grand Rapids, Mich., June 30, 1908.—Sealed proposals for repair of South Pier at Grand Haven, Mich., will be received here until 3 p. m., July 14, 1908, and then publicly opened. Information on application. M. B. ADAMS, Col. Engrs.

MACADAMIZING.

River Vale, N. J., July 6, 1908.

Sealed proposals for the macadamizing of Leslie Ave. and Westwood Ave., in the Township of River Vale, a distance of 1 1/6 miles, will be received by the Township Committee of the Township of River Vale, Bergen Co., N. J., and will be publicly opened at 7.30 p. m., on August 1st, at the regular place of meeting.

Plans and specifications may be examined at the office of the State Commissioner of Public Roads, State House, Trenton, N. J., or at the office of H. G. Hering, Jr., Engineer, Hillsdale, N. J.

Each bidder must enclose with his bid a certified check for One Thousand Dollars ($1,000), payable to the order of the Township of River Vale as a guarantee that if the said work is awarded to him he will enter into a contract with the said Township Committee for the due and faithful performance of the work, which contract, together with the bond of the successful bidder, must be executed within ten (10) days from the time of the formal awarding of the contract by the said Township Committee, the said bond to be conditioned for the faithful performance of the work in strict conformity with the plans and specifications, and in the penal sum of at least the total estimated cost of the work.

Both contract and bond must meet the approval of the State Commissioner of Public Roads and the Township Committee of the Township of River Vale.

The Township Committee reserves the right to reject any and all bids.

GEO. H. SEAMAN,
Chairman.

Attest:
J. W. B. DUNCAN,
Clerk.

COMMONWEALTH OF MASSACHUSETTS.—Metropolitan Sewerage Works.—Notice to Contractors.—Sealed proposals will be received at the office of the Metropolitan Water and Sewerage Board, 1 Ashburton Place, Boston, Mass., until 2.30 p. m., of Friday, July 31, 1908, for constructing in earth and rock trench a 60-inch by 72-inch concrete sewer and a 72-inch by 48-inch brick and concrete sewer, Section 86 of the Extension of the High Level Sewer, South Metropolitan System, in Washington Street, Brighton, in accordance with the forms of contract and specifications to be furnished by the Board. Some particulars are estimated to be as follows: length of 60-inch by 72-inch concrete sewer, 1,305 feet; length of 72-inch by 48-inch brick and concrete sewer, 1,135 feet; 300 cubic yards of Portland brick masonry; 3,000 cubic yards of concrete masonry in trench; 300 cubic yards rock excavation in trench. The invert of the sewer is from 8 feet to 26 feet below the street surfaces. Plans can be seen and specifications and forms of contract can be obtained at the above office. Each bid must be accompanied by a certified check for $2,000, payable to the Commonwealth of Massachusetts, and a bond in the sum of $15,000 will be required from the successful bidder. The Board reserves the right to reject any or all bids. HENRY H. SPRAGUE, HENRY P. WALCOTT, JAMES A. BAILEY, JR., Metropolitan Water and Sewerage Board. William M. Brown, Chief Engineer of Sewerage Works. William N. Davenport, Secretary.

WATER-WORKS.

Nowata, Okla.

Bids will be received by A. H. Gillespie, Recorder, Nowata, Oklahoma, and by him publicly opened, July 22d, nineteen hundred and eight, for the purchase by the City of Nowata of all material required in the construction of a municipal water-works system. Specifications may be had by addressing O'NEIL ENGINEERING COMPANY, Dallas, Texas.

OFFICE OF THE COMMISSIONERS OF THE DISTRICT OF COLUMBIA, Washington, June 30, 1908.—Sealed proposals will be received at this office until 12 o'clock noon, M., on Saturday, July 18, 1908, for grading and regulating suburban streets and avenues. Blank forms of proposals, specifications, and all necessary information will be furnished at the office of the Engineer Commissioner, D. C. HENRY B. F. MACFARLAND, HENRY L. WEST, JAY J. MORROW, Commissioners, D. C.

U. S. ENGINEER OFFICE, Newport, R. I., June 22, 1908.—Sealed proposals for dredging and removing rock from Pawtucket River, R. I., will be received here until 2 p. m., July 22, 1908, and then publicly opened. Information on application. HARRY TAYLOR, Maj., Engrs.

DEPARTMENT OF PUBLIC WORKS,
Bureau of Surveys,
Office, 412 City Hall,
Philadelphia, Pa.

Sealed proposals, endorsed "Proposals for Bridges, Main Sewers," and addressed to the undersigned, at the office aforementioned, will be received until 12 o'clock noon, on July 24, 1908, for

Schedule A. Bridges.
Schedule B. Bridges.

Plans for the above work will be exhibited in the office of Bureau of Surveys, Philadelphia.

Specifications and blank forms upon which bids must be made, will be furnished upon application to the Chief Engineer, Room 416 City Hall.

Bidders must be skilled and regularly engaged in the class of work bid for.

No bid will be considered unless accompanied by a certificate from the City Solicitor that the provisions of an ordinance requiring proposal bonds when the bids exceed in amount five hundred dollars, approved May 25, 1860 (p. 81, West), have been complied with.

The Director reserves to himself the right to reject any or all bids, as he may deem best for the interests of the city.

GEO. R. STEARNS,
Director.

FORT DUPONT, DELAWARE CITY, DEL., July 1, 1908.—Sealed proposals in triplicate, will be received here until 11 a. m., July 31, 1908, for Repairs to Wharf, Fort Mott, N. J. Information furnished upon application. A deposit of Five Dollars required on all plans and specifications loaned. U. S. reserves right to accept or reject any or all bids or any part thereof. Envelopes containing bids should be indorsed "Proposals for Repairs to Wharf," and addressed to Captain J. L. KNOWLTON, Constructing Quartermaster, Fort Du Pont, Del.

SEALED PROPOSALS, indorsed "Proposals for Marine Railway," will be received at the Bureau of Yards and Docks, Navy Department, Washington, until 11 o'clock a. m., August 1, 1908, and then and there publicly opened, for constructing a marine railway at the naval station, Key West, Fla. Plans and specifications can be obtained on application to the Bureau or to the Commandant of the naval station named. R. C. HOLLYDAY, Chief of Bureau, June 25, 1908.

DEPARTMENT OF THE INTERIOR, U. S. Reclamation Service, Washington, D. C., June 26, 1908.—Sealed proposals will be received at the office of the United States Reclamation Service, Phoenix, Arizona, until 9 o'clock a. m., August 3, 1908, for the furnishing and hauling of about 33,000 barrels of fuel oil for use in the cement mill at Roosevelt, Arizona. For particulars address the United States Reclamation Service, Washington, D. C., or Phoenix, Arizona. FRANK PIERCE, Acting Secretary.

Miscellaneous Wants

CEMENT OPPORTUNITY in Middle California. Limestone and clays for high-grade Portland cement lying close together and close to railroad with gravity grade. Supply practically inexhaustible and cheap fuel. Coast demand large and increasing steadily. Also big deposits of pure gypsum for plaster paris. Sale or lease. Address W. G. SLAUSON, Room 27, Blackstone Building, Cleveland, Ohio. 2-1t

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